Agenda Item No. 3

Meeting of the Reclamation Board
June 8, 2007

Reclamation Board Staff Report

Item

a. Consider approval of Cooperation Agreement with TRLIA, Reclamation District 784, and Yuba County for the left bank Feather River and Yuba River levees project as described in item C.
b. Consider approval of a letter to the U. S. Army Corps of Engineers requesting modification of federal flood control project as described in item C.
c. Consider approval of Application No. 18170 for improvements to the left (east) bank levees of the Feather River and Yuba River by constructing seepage control measures and levee crown and slope restoration. The proposed improvements include seepage cutoff walls, stability berms, waterside blankets, crown reshaping, waterside levee slope flattening and relief wells.

Applicant

Three Rivers Levee Improvement Authority, a joint powers agency created by the County of Yuba and Reclamation District No. 784.

Location

The project is located on the left bank of the Feather River levee and the left bank of the Yuba River levee in Yuba County. This reach of the levee is maintained by Reclamation District 784.

Description

The Applicant is seeking a Board encroachment permit to make modifications to Segments 1 and 3 of the Feather River left bank levee by constructing the following:

Segment 1 (PLM 13.3 to PLM 17.1 Feather River; GEI Sta 44+90 to Sta 249+00):

a) approximately 3,150 linear-feet of slurry cut-off wall from Sta 135+00 to Sta 166+50,
b) approximately 2,175 linear-feet of slurry cut-off wall from Sta 198+00 to Sta 219 +75,
c) approximately 2,750 linear feet of waterside toe cutoff wall from Sta 221+50 to Sta 249+00,
d) approximately 2,600 linear-feet of low permeability waterside blankets from Sta 78+00 to Sta 104+00, (may be constructed by the Corps)

e) approximately 1,700 linear feet of low permeability waterside blankets from Sta 182+00 to Sta 199+00, and
f) sixteen relief wells between Sta 44+90 to Sta 88+50 (may be installed by the Corps).

Segment 3 (PLM 23.6 to PLM 26.07 Feather River and PLM 0.0 to PLM 0.3 Yuba River; GEI Sta 570+00 to Sta 724+00):

a) approximately 6,200 linear feet of slurry cut-off wall from Sta 570+00 to Sta 632+00,
b) approximately 2,700 linear feet of stability berm from Sta 631+00 to Sta 658+00,
c) approximately 3,100 linear-feet of waterside levee slope flattening from Sta 659+00 to Sta 690+00,
d) approximately 300 feet of crown reshaping on the Feather River east levee from Sta 593+73 to Sta 596+73,
e) approximately 400 linear-feet of crown reshaping on the Yuba River left bank from Sta 714+73 to Sta 718+73.

The strengthening project will require removal of levee material from remnant Feather and Bear River levees south of the Bear River setback levee for use as fill materials for reconstruction of the embankment sections degraded for cutoff wall construction, construction of new stability berms, construction of waterside blankets, and replacement of patrol road surfacing material removed during levee degradation. The removal of the remnant Feather and Bear River levees is allowed under Reclamation Board Permit 17979-BD.

Construction of cut-off wall in Segment 3 will require removal of the existing Linda County Water District Wastewater Treatment Plant 's effluent discharge pipe and construction of a new discharge pipe after the cut-off wall is constructed; and partial removal of Plumas Mutual Water Company's irrigation piping in Segment 1 and restoration after construction. Two abandoned 36-inch corrugated metal pipes that extend beneath the embankment in the vicinity of the PMWC pump station will be removed permanently.

Background

Since the formation of the Three Rivers Levee Improvement Authority in 2004, TRLIA has undertaken levee improvements for the Bear River, Western Pacific Interceptor Canal, and the Yuba River levees. The proposed improvements along the left bank levee of the Feather River and a small portion of the left bank levee of the Yuba River are part of TRLIA's Phase 4 Levee Improvement Project. The project is divided into three segments. Segment 1 encompasses the Feather River left levee from the tie-in with the Bear River setback levee at Project Levee Mile 13.3 (PLM 13.3) to Star Bend (PLM 17.1). Segment 2 is from Star Bend (PLM 17.1) to about one mile north of Murphy Road at PLM 23.3. Segment 3 is from PLM 23.3 to the Yuba River tie-in (PLM 26.1), and the Yuba River left levee from the tie-in with the Feather River (PLM 0.0) to the Union Pacific Railroad bridge (PLM 0.3).

This application is for the strengthening of the levees in Segments 1 and 3. It is understood that the U. S. Army Corps of Engineers may undertake the construction of 2,600 linear-feet of low permeability waterside blankets and 16 relief wells at the Site 7 Extension within Segment 1; however, TRLIA has designed the blankets and relief wells as an option for TRLIA if the Corps is not able to meet the required repair schedule for FEMA. Segment 2 improvements will be addressed under TRLIA's last stage of Phase 4 levee repairs.

RD 784 encompasses approximately 17,000 acres within Yuba County. The predominant land use within RD 784 watershed is agriculture, but there is concentrated urban development in Linda and Olivehurst and additional large-scale urban development is occurring within the District. The Plumas Lake Specific Plan adopted by Yuba County in 1993 provides the framework for development of over 11,800 homes on approximately 5,300 acres within RD 784. As of 2006, approximately 3,000 new homes had been built or were under construction within the Plumas Lake Specific Plan area.

The existing Feather River levee alignment protects RD 784 from flooding by the Feather River. The project area follows along the east side of the Feather River from the Bear River setback levee tie-in, to the Feather River confluence with the Yuba River where the Feather River east levee ties into the Yuba River south levee. The Corps completed construction of this levee in 1941. Since its construction, the levee between Shanghai Bend (PLM 23.6) and the Bear River confluence (PLM 13.3) has experienced recurring, serious seepage problems during high river stages. Major modifications, reconstructions, and upgrades have been implemented by the Corps over the years in response to deficiencies identified during flood events. Following the 1986 breach of the Yuba River levee, the Corps conducted an extensive levee evaluation and reconstruction effort of the Sacramento River Flood Control system. The evaluation and reconstruction work consisted of raising levees, constructing cut-off slurry walls, constructing stability berms and seepage berms, and constructing relief wells and drainage ditch system. In 1998, the Corps conducted a feasibility study to increase the level of flood protection to Yuba County. The project is currently being reevaluated by the Corps. A Yuba Basin General Reevaluation Report, which is currently being prepared for submission to Congress for a new authorization, is expected to be available to Congress for its consideration in 2008. The earliest that federal construction under the Corps' reauthorized project could begin is 2010.

Despite the improvements implemented by the Corps after the 1986 and 1997 flood events, seepage problems continue to occur along the east levee of the Feather River. During a high water event in January 2006, boils were observed in the Pump Station No. 3 intake channel and along the toe of the seepage berm about 1,160 feet downstream of the pump station and 300 feet landward of the levee toe. The boils occurred at approximately the same location as the boils observed during the 1986 and 1997 flood events. Seeps were observed at the toe of the seepage berm about 1,900 feet downstream of Pump Station No. 3, also 300 feet landward of the levee. The seeps were located in the general location of a large boil that formed during the 1986 and 1997 flood events. Seeps were also observed just north of Pump Station No. 3. A boil was observed in the intake channel of Pump Station No. 2, and two seeps were

observed in a ditch adjacent to the levee downstream of the pump station. A portion of the relief well/drainage ditch system upstream of Pump Station No. 2 was damaged as a result of uplift. The Corps repaired the relief well/drainage ditch system and installed four relief wells in the vicinity of the repaired ditch. In addition, the Corps constructed four relief wells around Pump Station No. 2 intake ditch.

Discussion:

On May 18, 2007, the Board at its regular meeting postponed consideration of TRLIA's Application No. 18170 to address the applicant's objection to the easement requirement as specified in Condition 14 of the draft permit. Condition 14 of the draft permit would have required that TRLIA provides the Board easement in the area within the floodway, the levee section, and the area 50 feet in width adjacent to the landward levee toe and landward toe of seepage berms.

At the direction of the Board, staff met with the Applicant to resolve concerns related to the scope of the easement sought. As a result of that meeting, Board staff has determined that it is not critical to obtain easement within the floodway since the Board regulates encroachments within the floodway, and recommends elimination of that requirement.

Staff recommends that the Board require a 50-foot easement beyond the landward levee toe where feasible to do so for the following reasons:

1. The area has a history of levee failures, and future levee repairs, requiring widening of the existing levee footprint, can be expected for the following reasons:
    a. Uncertainty in subsurface and foundation materials used to select and design seepage control measures,
    b. Uncertainty in the performance and effectiveness of seepage control measures,
    c. Changing Corps criteria,
    d. Impacts of global warming, and
    e. Impacts of new State Plan of Flood Control
2. The Feather River levee has a long history of failures primarily caused by underseepage and through-seepage problems. Despite repairs made during the last several decades, these problems continue to recur. An area should be reserved for construction of future levee upgrades and seepage control measures such as seepage berms, relief wells, levee widening, and levee raises.
3. For flood fight activities, the minimally acceptable distance for work crew safety and efficient use of equipment – two-way truck traffic, truck turn-around, and backing into levee is fifty feet.
4. For long-term operations and maintenance, an easement wider than ten feet is preferable for worker safety and for passage of large equipment.
5. The area is projected to be highly urbanized. A wider buffer between human habitation and the flood control system is desirable based on our experience with difficulty controlling human encroachment which endangers the integrity of our system. It is a common sight to see people living near our levees extending their

backyard fences, planting and installing landscape irrigation system very close to our levees, and building structures such as steps on the slopes of our levees.

Staff reviewed existing land uses adjacent to the landward toe of the levee and proposed seepage berms. Staff determined that the Segment 1 area is being used for agricultural purposes, and that it would be feasible to acquire a 50-foot easement on the landward toe of the levee for this area. Board staff recommends that such easement not preclude current or future agricultural practices that are not inconsistent with the levee easement.

Staff also determined that the area adjacent to the toe of the landward levee along Segment 3 is mostly developed, consisting of residential homes and other structures including the Linda Water District Wastewater Treatment Plant. A CALTRANS environmental mitigation site is also located alongside the landward levee toe. Because of the level of development in this area, staff recommends the Board acquire the standard 10-foot easement for Segment 3. TRLIA and Board staff will determine activities that will be limited or prohibited within these easements. A revised draft permit (Attachment A) is attached incorporating the revisions for Condition 14 and other conditions related to the 50-foot easements.

Staff of the U. S. Army Corps of Engineers informed the Board at the May 18, 2007 meeting that it cannot accept the letter sent by the Board on May 1, 2007 requesting the Corps determination on the appropriate regulation or law to be applied on the modification project. The Corps requires that the Board provides assurance that it will accept the project once incorporated in the federal project for operation and maintenance and to hold and save the United States free from damage due to the construction works. The Board has agreed to send a revised letter providing the assurance requested by the Corps. A copy of the draft letter for Board approval is attached as Attachment B.

In connection with the Corps requirement that the State provides assurance to operate and maintain the modified project and to indemnify the federal government, the Board in turn seeks the same from TRLIA, RD 784 and Yuba County. A draft Cooperation Agreement (Attachment C) is being prepared for review and execution by the Board, TRLIA, RD 784 and Yuba County. The Cooperation Agreement requires that RD 784 accepts the modified project for operations and maintenance and Yuba County indemnifies and holds and saves the Reclamation Board and the State of California free from damage due to the construction works.

Hydraulic Impacts

The proposed project does not involve raising levees above the 1957 profile nor include relocating or realigning levees. The seepage calculations show an increase of 2 cubic feet per second flowing into the Feather River as a result of the levee strengthening measures. Because the Feather River Channel is designed to carry 300,000 cfs at this location, a theoretical increase of 2 cfs is not measurable and is considered by staff to have essentially no hydraulic impact on the system.

Environmental Review

TRLIA certified a Final Environmental Impact Report for all proposed improvements works in the east levee of the Feather River within RD 784, including the proposed project in this application; staff has reviewed project's environmental documents submitted to the Board and makes the following findings:

IMPACT 5.2-a. Potential temporary, short-term construction-related erosion.

Finding: The Reclamation Board finds that changes or alterations have been required in or incorporated into, the project which mitigate or avoid the significant effect of causing potential temporary, short-term construction-related erosion surrounding the construction. During construction, Standard Best Management Practices (BMP's), will be recognized as well as the contractor chosen by the TRLIA will prepare and Implement a Storm Water Pollution Prevention Plan (SWPPP), as well as comply with National Pollutant Discharge Elimination System (NPDES) Permit Conditions. TRLIA will comply with local Yuba County permit conditions for erosion control during all aspects and phases of the construction process. These mitigation measures will reduce the effects to less than significant. Citation: Final EIR, Mitigation and Monitoring Reporting Plan page 3-5.

IMPACT 5.3-a. Temporary water quality effects from storm water runoff, erosion, and spills associated with construction.

Finding: The Reclamation Board finds that changes or alterations have been required in or incorporated into, the project which mitigate or avoid the significant effect of causing potential temporary, short-term construction-related erosion surrounding the construction. During construction, Standard Best Management Practices (BMP's), will be recognized as well as the contractor chosen by the TRLIA will prepare and Implement a Storm Water Pollution Prevention Plan (SWPPP), as well as Comply with National Pollutant Discharge Elimination System (NPDES) Permit Conditions. TRLIA will comply with local Yuba County permit conditions for erosion control during all aspects and phases of the construction process. These mitigation measures will reduce the effects to less than significant. Citation: Final EIR, Mitigation and Monitoring Reporting Plan page 3-5.

The Board's Environmental Review Committee has reviewed the application and the project's environmental documentation. The ERC finds the project to be in compliance with CEQA.

Policy Considerations

The purpose of this application is to construct a cutoff wall, stability berms, waterside blankets, relief wells, levee slope flattening, and levee crown reshaping within the federal flood control project levee. This modification to the flood control project will

require Corps approval. On May 1, 2007 the Reclamation Board sent a letter to Corps requesting permission to modify the federal flood control project. At the May 18, 2007 Board meeting, the Corps of Engineers notified the Board that the May 1, 2007 letter was unsatisfactory to the Corps and that a revised letter should be sent specifying that the State of California acting through the Board will accept the altered project for operation and maintenance and hold and save the United States free from damage from damage due to the construction works. The Board is also seeking assurance from TRLIA, RD 784, and Yuba County to accept the modified project for operations and maintenance and to indemnify the State of California.

Staff Recommendations

Staff recommends that the Board approve the project as described, approve draft permit No. 18170 and authorize the General Manager to finalize and issue the permit. Staff also recommends approval of the draft revised Corps letter and the draft Cooperation Agreement.

Attachments

A. Draft Permit
B. Draft Corps Letter
C. Draft Cooperation Agreement

ATTACHMENT A

DRAFT

STATE OF CALIFORNIA
THE RESOURCES AGENCY

THE RECLAMATION BOARD

PERMIT NO. 18170 BD

This Permit is issued to:

Three Rivers Levee Improvement Authority
915 Eighth Street, Suite 115
Marysville, California 95901-5273

To construct cutoff walls and stability berms, waterside blankets and relief wells between Levee Miles 13.3 to 17.1 (segment 1) and 23.6 to 26.1 (segment 3), and flatten 3,000 feet of waterside slope between Levee Miles 23.6 and 26.1 on the left (east) bank levee of the Feather River; and reshape levee crown from Levee Mile 0.0 to 0.3 on the left (south) bank levee of Yuba River and between Levee Miles 23.6 and 26.1 on the left (east) bank levee of the Feather River. The project is located south of Marysville and west of Highway 70 (Section 26,35,1, T14N, R3E, MDB&M, Reclamation District 784, Feather River, Yuba County).

NOTE: Special Conditions have been incorporated herein which may place limitations on and/or require modification of your proposed project described above.

(SEAL)

Dated: _____

_____
General Manager

GENERAL CONDITIONS:

ONE: This permit is issued under the provisions of Sections 8700 – 8723 of the Water Code.

TWO: Only work described in the subject application is authorized hereby.

THREE: This permit does not grant a right to use or construct works on land owned by the Sacramento and San Joaquin Drainage District or on any other land.

FOUR: The approved work shall be accomplished under the direction and supervision of the State Department of Water Resources, and the permittee shall conform to all requirements of the Department and The Reclamation Board.

FIVE: Unless the work herein contemplated shall have been commenced within one year after issuance of this permit, the Board reserves the right to change any conditions in this permit as may be consistent with current flood control standards and policies of The Reclamation Board.

SIX: This permit shall remain in effect until revoked. In the event any conditions in this permit are not complied with, it may be revoked on 15 days' notice.

SEVEN: It is understood and agreed to by the permittee that the start of any work under this permit shall constitute an acceptance of the conditions in this permit and an agreement to perform work in accordance therewith.

EIGHT: This permit does not establish any precedent with respect to any other application received by The Reclamation Board.

NINE: The permittee shall, when required by law, secure the written order or consent from all other public agencies having jurisdiction.

TEN: The permittee is responsible for all personal liability and property damage which may arise out of failure on the permittee's part to perform the obligations under this permit. If any claim of liability is made against the State of California, or any departments thereof, the United States of America, a local district or other maintaining agencies and the officers, agents or employees thereof, the permittee shall defend and shall hold each of them harmless from each claim.

ELEVEN: The permittee shall exercise reasonable care to operate and maintain any work authorized herein to preclude injury to or damage to any works necessary to any plan of flood control adopted by the Board or the Legislature, or interfere with the successful execution, functioning or operation of any plan of flood control adopted by the Board or the Legislature.

TWELVE: Should any of the work not conform to the conditions of this permit, the permittee, upon order of The Reclamation Board, shall in the manner prescribed by the Board be responsible for the cost and expense to remove, alter, relocate, or reconstruct all or any part of the work herein approved.

SPECIAL CONDITIONS FOR PERMIT NO. 18170 BD

THIRTEEN: This permit is not valid until the Board has been granted written permission by the U. S. Army Corps of Engineers to allow the federal flood control project to be modified as described by this permit.

FOURTEEN: Within three years from completion of the modifications approved by this permit, the permittee shall provide the Sacramento and San Joaquin Drainage District, acting by and through The Reclamation Board of the State of California, a permanent easement granting all flood control rights upon, over and across the property to be occupied by the existing or to-be-reconstructed levee, including the areas of the cutoff walls, waterside blankets, relief wells, and stability berms. The easement must include the entire levee section including waterside blankets, relief wells, stability berms and the area ten (10) feet in width adjacent to the landward toe if the area is not presently encumbered by a Reclamation Board easement. In addition, the permittee shall provide an easement for an additional forty (40) feet along the landward levee toe of segment 1 (L.M. 13.3 to L.M. 17.1). The permittee shall work with Board staff to determine what activities shall be limited or prohibited within this additional easement. For information regarding existing Reclamation Board easements and required easements, please contact Jeff Fong at (916) 657-2831.

FIFTEEN: For work proposed on land owned in fee or easement by Reclamation District No. 784, the permittee may be required to secure an easement, license, or permit from the District prior to commencement of work.

SIXTEEN: All work approved by this permit shall be in accordance with the submitted drawings and specifications except as modified by special permit conditions herein. No further work, other than

that approved by this permit, shall be done in the area without prior approval of The Reclamation Board.

SEVENTEEN: The maximum levee crown elevations of the levee reaches addressed by this permit shall be limited to the maximum crown elevations shown for the same reaches on the US Army Corps of Engineers' Sacramento River Flood Control Project, California, Levee and Channel Profiles, dated March 15, 1957, or as modified by the Corps of Engineers and shown on "as-built" drawings provided to the Reclamation Board subsequent to March 15, 1957.

EIGHTEEN: Upon completion of the project, the permittee shall submit a levee crown profile survey, certified by a licensed land surveyor or professional civil engineer registered in the State of California, to The Reclamation Board showing that the new levee crown profile does not exceed the requirements designated in Condition Seventeen.

NINETEEN: The permittee shall maintain the permitted encroachment(s) and the project works within the utilized area in the manner required and as requested by the authorized representative of the Department of Water Resources or any other agency responsible for maintenance.

TWENTY: The permittee shall contact the Department of Water Resources by telephone, (916) 574-1213, and submit the enclosed postcard to schedule a preconstruction conference. Failure to do so at least 10 working days prior to start of work may result in delay of the project.

TWENTY-ONE: The permittee shall provide supervision and inspection services acceptable to The Reclamation Board. A professional engineer registered in the State of California shall certify that all work was inspected and performed in accordance with submitted drawings, specifications, and permit conditions.

TWENTY-TWO: If FEMA certification of the levee by the Corps of Engineers is being considered, the project proponent should contact the U. S. Army Corps of Engineers regarding inspection of the project during construction for FEMA certification purposes.

TWENTY-THREE: The permittee shall contact the U. S. Army Corps of Engineers regarding inspection of the project as the proposed work is a modification to the existing Federal Flood Control Project and is expected to be incorporated into the adopted plan of flood control.

TWENTY-FOUR: The Reclamation Board and Department of Water Resources shall not be held liable for any damages to the permitted encroachment(s) resulting from flood fight, operation, maintenance, inspection, or emergency repair.

TWENTY-FIVE: The permittee may be required, at permittee's cost and expense, to remove, alter, relocate, or reconstruct all or any part of the permitted encroachment(s) if removal, alteration, relocation, or reconstruction is necessary as part of or in conjunction with any present or future flood control plan or project or if damaged by any cause. If the permittee does not comply, The Reclamation Board may remove the encroachment(s) at the permittee's expense.

TWENTY-SIX: The permittee should contact the U.S. Army Corps of Engineers, Sacramento District, Regulatory Branch, 1325 J Street, Sacramento, California 95814, telephone (916) 557-5250, as compliance with Section 10 of the Rivers and Harbors Act and/or Section 404 of the Clean Water Act

may be required.

TWENTY-SEVEN: The permittee shall be responsible for repair of any damages to the project levee and other flood control facilities due to construction, operation, or maintenance of the proposed project.

TWENTY-EIGHT: The permittee is responsible for all liability associated with construction, operation, and maintenance of the permitted facilities and shall defend and hold harmless the State of California, or any departments thereof, from any liability or claims of liability associated therewith.

TWENTY-NINE: If the project, or any portion thereof, is to be abandoned in the future, the permittee or successor shall abandon the project under direction of The Reclamation Board and Department of Water Resources, at the permittee's or successor's cost and expense.

THIRTY: Upon completion of the project, the permittee shall submit as-built drawings to: Department of Water Resources, Flood Project Inspection Section, 3310 El Camino Avenue, Suite LL30, Sacramento, California 95821.

THIRTY-ONE: No construction work of any kind shall be done during the flood season from November 1 to April 15 without prior approval of The Reclamation Board.

THIRTY-TWO: Cleared trees and brush shall be completely burned or removed from the floodway, and downed trees or brush shall not remain in the floodway during the flood season from November 1 to April 15.

THIRTY-THREE: No material stockpiles, temporary buildings, or equipment shall remain in the floodway during the flood season from November 1 to April 15.

THIRTY-FOUR: The permitted encroachment(s) shall not interfere with operation and maintenance of the flood control project. If the permitted encroachment(s) are determined by any agency responsible for operation or maintenance of the flood control project to interfere, the permittee shall be required, at permittee's cost and expense, to modify or remove the permitted encroachment(s) under direction of The Reclamation Board or Department of Water Resources. If the permittee does not comply, The Reclamation Board may modify or remove the encroachment(s) at the permittee's expense.

THIRTY-FIVE: During construction of the project, any and all anticipated or unanticipated conditions encountered which may impact levee integrity or flood control shall be brought to the attention of the Flood Project Inspector immediately and prior to continuation. Any encountered abandoned encroachments shall be completely removed or properly abandoned under the direction of the Flood Project Integrity and Inspection Branch Inspector.

THIRTY-SIX: The stability of the levee shall be maintained at all times.

THIRTY-SEVEN: Excavations below the design flood plane and within the levee section or within ten (10) feet of the projected waterward and landward levee slopes shall have side slopes no steeper than 1 horizontal to 1 vertical. Flatter slopes may be required to ensure stability of the excavation.

THIRTY-EIGHT: A profile of the levee crown roadway and all access ramps that will be utilized for

access to and from the borrow and project areas shall be submitted to The Reclamation Board prior to commencement of excavation.

THIRTY-NINE: Any haul and access ramps and utilized levee crown roadway shall be maintained in a manner prescribed by the authorized representative of the Department of Water Resources or any other agency responsible for maintenance.

FORTY: Any damage to the levee crown roadway or access ramps that will be utilized for access for this project shall be promptly repaired to the condition that existed prior to this project.

FORTY-ONE: Equipment used in the construction of the cutoff walls shall not exceed live-load surcharge to a level that causes or contributes to the instability of the levee during construction operations.

FORTY-TWO: Fluid pressures in the cutoff wall construction zones shall be carefully monitored and controlled to minimize the potential for hydrofracturing.

FORTY-THREE: The permittee shall be responsible for all damages due to settlement, consolidation, or heave from any construction-induced activities.

FORTY-FOUR: Excess bentonite or other cutoff wall fluids shall be properly disposed of outside of the floodway. The bentonite or other cutoff wall fluids shall not be used as backfill material for levee reconstruction.

FORTY-FIVE: Restoration of the degraded levee shall not begin until the cutoff wall has cured and achieved at least 80 percent of its design strength prior to beginning backfill or as allowed by the Corps.

FORTY-SIX: All fencing, gates and signs removed during construction of this project shall be replaced in kind and at the original locations. If it is necessary to relocate any fence, gate or sign, the permittee is required to obtain written approval from The Reclamation Board prior to installation at a new location.

FORTY-SEVEN: All temporary fencing, gates and signs shall be removed upon completion of the project.

FORTY-EIGHT: Any pipe or conduit being reinstalled in the levee section or within ten (10) feet of both the waterward and landward levee toes shall meet Title 23 standards.

FORTY-NINE: Fill on the levee slope shall be keyed into the existing levee section with each lift.

FIFTY: Backfill material for excavations within the levee section and within ten (10) feet of the levee toes shall be placed in 4- to 6-inch layers, moisture conditioned above optimum moisture content, and compacted to a minimum of 90 percent relative compaction as measured by ASTM Method D1557-91.

FIFTY-ONE: Density tests by a certified materials laboratory will be required to verify compaction of backfill within the levee section and within ten (10) feet of the levee toes.

FIFTY-TWO: No cuts shall remain in the levee section upon completion of fill placement.

FIFTY-THREE: Fill material shall be placed only within the area indicated on the approved plans.

FIFTY-FOUR: All fill material for reconstructing the levee crown fill areas and waterside blankets shall be impervious material with 20 percent or more passing the No. 200 sieve, a plasticity index of 8 or more, and a liquid limit of less than 50 and free of lumps or stones exceeding 3 inches in greatest dimension, vegetative matter, or other unsatisfactory material.

FIFTY-FIVE: The fill surface areas shall be graded to direct drainage away from the toe of the levee.

FIFTY-SIX: The slopes of the reconstructed levee sections shall be no steeper than 3 horizontal to 1 vertical on the water side and 2 horizontal to 1 vertical on the land side.

FIFTY-SEVEN: The reconstructed levee crown roadway and access ramps shall be surfaced with a minimum of 4 inches of compacted, Class 2, aggregate base (Caltrans Specification 26-1.02A).

FIFTY-EIGHT: Aggregate base material shall be compacted to a relative compaction of not less than 95 percent per ASTM Method D1557-91, with a moisture content sufficient to obtain the required compaction.

FIFTY-NINE: The project sites including the levee sections and access ramps shall be restored to at least the condition that existed prior to commencement of work.

SIXTY: All debris generated by this project shall be disposed of outside the floodway and off the levee sections.

SIXTY-ONE: The permittee shall replant or reseed the levee slopes to restore sod, grass, or other non-woody ground covers if damaged during project work.

SIXTY-TWO: In the event existing revetment on the channel banks or levee slopes is disturbed or displaced, it shall be restored to its original condition upon completion of the proposed installation.

SIXTY-THREE: In the event that levee or bank erosion injurious to the adopted plan of flood control occurs at or adjacent to the permitted encroachment(s), the permittee shall repair the eroded area and propose measures, to be approved by The Reclamation Board, to prevent further erosion.

SIXTY-FOUR: The permittee shall comply with all conditions set forth in the letter from the Department of the Army dated May 17, 2007, which is attached to this permit as Exhibit A and is incorporated by reference excluding Condition 'c' which may be in conflict with Condition Seventeen of this permit.

SIXTY-FIVE: This permit is not valid until the permittee has resolved all comments provided by the Corps of Engineers in Exhibit A. All responses to the Corps of Engineers shall also be provided to The Reclamation Board.

SIXTY-SIX: No material, other than temporary materials during construction, shall be stockpiled

closer than 50 feet from the landward toe of the project levee.

SIXTY-SEVEN: Any damage caused to the levees during placement or removal of any stockpiled material shall be repaired.

SIXTY-EIGHT: The waterside blankets, relief wells and stability berms are considered flood control project features and are subject to Title 23 California Code of Regulations.

SIXTY-NINE: Concrete pipe for the Linda County Water District discharge pipe replacement shall be AWWA C300 reinforced concrete cylinder pipe within the levee section and 10 feet landward and waterward of the levee toes. The permittee shall submit a joint detail for the pipe for approval by The Reclamation Board prior to pipe installation.

SEVENTY: The high-density polyethylene pipe to be used for the Plumas Mutual pipeline replacement shall meet the following conditions: (a) high-density polyethylene pipeline or conduit joints must be heat or electrofusion welded (ASTM Standard F1055-93, dated 1993 or D3261-93, dated 1993), (b) high-density polyethylene pipelines and conduits must be designed to resist all anticipated loading conditions, and (c) high-density polyethylene pipelines and conduits must be ultraviolet radiation protected.

SEVENTY-ONE: All reconstructed pipelines shall be tested and confirmed free of leaks by X-ray, pressure tests, or other approved methods during construction or anytime after construction upon request by The Reclamation Board.

SEVENTY-TWO: All abandoned piping and conduits shall be removed from the levee section.

SEVENTY-THREE: Upon completion of the project, the permittee shall submit to The Reclamation Board proposed revisions to the Corps of Engineers, Supplement to Standard Operation and Maintaince Manual, Sacramento River Flood Control Project, Unit No. 145 Part 1, incorporating the cutoff walls, waterside blankets, relief wells, stability berms or any other system modifications implemented as part of this permit as project features.

SEVENTY-FOUR: By acceptance of this permit, the permittee (Three Rivers Levee Improvement Authority) acknowledges the authority of The Reclamation Board to regulate all future encroachments along these levee reaches including those that may encroach upon the modifications approved by this permit.

SEVENTY-FIVE: Any additional encroachment(s) in the floodway, on or in the levee section and within the easements required under Condition Fourteen require an approved permit from The Reclamation Board.

SEVENTY-SIX: The disposal sites shall be located no closer than two hundred (200) feet from the landside toe of the Feather River levee and no closer than fifty (50) feet from the landside toe of the Bear River levee unless the revised underseepage analyses indicate a greater distance is required.

SEVENTY-SEVEN: The ground surface grading between the landside toes of the Feather River and Bear River levees and the disposal sites shall be contoured to allow surface runoff to drain away from the levee toes.

SEVENTY-EIGHT: This permit is not valid until a Cooperation Agreement for the project that provides local assurances to operate and maintain the completed project and to hold harmless and indemnify the Board and State of California satisfactory to the Board is executed among the Board, Three Rivers Levee Improvement Authority, Reclamation District 784, and Yuba County.

STATE OF CALIFORNIA – THE RESOURCES AGENCY
ARNOLD SCHWARZENEGGER, GOVERNOR

THE RECLAMATION BOARD
3310 El Camino Ave., Rm. LL40
SACRAMENTO, CA 95821
(916) 574-0609 FAX: (916) 574-0682
PERMITS: (916) 574-0653 FAX: (916) 574-0682

June 8, 2007

Attachment B

Colonel Ronald N. Light
U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, California 95814

Dear Colonel Light:

The California Reclamation Board (Board) is requesting review by the U.S. Army Corps of Engineers (Corps), on behalf of the Three Rivers Levee Improvement Authority (Three Rivers), to modify a portion of the Sacramento River Flood Control Project (SRFCP). The enclosed report describes the proposed modification project. Three Rivers has received a permit from the Board for modification of the east bank levees of the Feather River and Yuba River.

Once the modification project has been completed and the modification has been formally incorporated within the federal project by the Corps, the State of California, acting through the Board, will accept the modified project for operation and maintenance and hold and save the United States free from damage due to the construction works.

Within 180 days of completion of the project modification, the Board will provide information to the Corps for the purposes of preparing a revised Operation and Maintenance Manual for this portion of the SRFCP, and as-built Plans and Specifications for the modification.

In order to achieve the flood control benefits of the setback levee prior to the 2007-2008 flood season, the Board is requesting that the Corps' review be completed so that Three Rivers may proceed with this alteration no later than July 1, 2007.

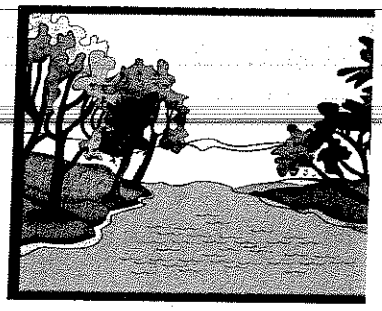
If you have any questions or need further information, please contact me at (916) 574-0609, or your staff may contact Dan Fua at (916) 574-0698.

Sincerely,

Jay S. Punia
General Manager

Enclosure

cc: Mr. Paul Brunner, Executive Director
Three Rivers Levee Improvement Authority
Yuba County 1- Stop Center
1114 Yuba Street, Suite 218
Marysville, California 95901



THREE RIVERS LEVEE IMPROVEMENT AUTHORITY

1114 Yuba Street, Suite 218
Marysville, CA 95901
(530) 749-7841 Fax (530) 749-6990

Summary Report to Support the Alteration to the Sacramento River Flood Control Project Feather River Segments 1 and 3 Levee Repair Project April 30, 2007

PURPOSE OF THIS REPORT

The Three Rivers Levee Improvement Authority (TRLIA) has requested approval from the California Reclamation Board (Board) to construct TRLIA-proposed repairs to the Federal Project levees along the left bank of the Feather and Yuba Rivers within Reclamation District (RD) 784, Yuba County, California. In turn, the Board is requesting a determination from the U.S. Army Corps of Engineers' (Corps) allowing modification of the federal project as determined by TRLIA.

The existing levees are part of the Sacramento River Flood Control Project (SRFCP) and designated as Federal "project levees." This portion of the SRFCP has foundation deficiencies under design conditions (1957 profile). The proposed alteration will strengthen levees in place and is designed to the 200-year flood event using current Corps design standards. This alteration will occur from Project Levee Mile (PLM) 13.3 to 17.2 of the Feather River East Levee (Segment 1) and from PLM 23.3 to 26.1 of the Feather River East Levee and PLM 0.0 to 0.3 of the Yuba River South Levee (Segment 3). The alteration will consist of strengthen in place features to enable the levees to withstand the 200-year flood event. Typical repair features consist of additional relief wells, slurry walls, and stability berms.

In a memorandum dated October 23, 2006, on Policy and Procedural Guidance for the Approval of Modification and Alteration of Corps of Engineer Projects, the Corps has directed that the following information be provided with any request for the approval of significant modifications or alterations to a locally or federally maintained Corps project requiring the Chief of Engineers approval under 33 USC 408:

1. A written request by the non-Federal interests for approval of the project modification/alteration.
2. Physical and functional description of the existing project
3. Detailed description of the proposed modification
4. Purpose/need for the modification
5. Description of any related, ongoing Corps studies/efforts in the watershed
6. A Public Interest Determination
7. Appropriate NEPA documentation
8. Administrative Record
9. A discussion of Indirect effects
10. A discussion of E.O. 11988 considerations
11. Technical Analysis:
    - Technical adequacy of the design
    - Changes in water surface profiles and flow distribution
    - Assessment of anticipated local and system-wide resultant impacts, i.e., impacts on system integrity

- Upstream and downstream impacts of the proposed alterations, including potential impacts to existing floodplain management and water control management plans of Federal projects within the basin
- A discussion of residual risk

The purpose of this report is to provide information regarding items 2, 3, 4, 5, 6, 7, 9, and 11 above. This report is organized in nine sections:

1. Overview of the Proposed Action, Including Public Interest Benefits (covering items 2, 3, 4, & 6)
2. Purpose/Need for the Modification (covering items 4, 5, & 6)
3. Existing Project Facilities and Deficiencies (covering items 2, 5, & 6)
4. Summary of Analyses and Evaluation Criteria (covering item 11)
5. Proposed Modifications (covering items 3 & 4)
6. Local and Systemwide Hydraulic Effects of the Levee Modification (covering items 9 & 11)
7. NEPA Documentation; Compliance with CEQA (covering item 7)
8. Studies in Support of the Feather River Levee Repair Project (covering all items)

References to source documents are included. Copies of the source documents have been issued to the Sacramento District. We understand that the Sacramento District will address items 8 and 10.

1. OVERVIEW OF THE PROPOSED ACTION, INCLUDING PUBLIC INTEREST BENEFITS

General

The purpose of the Feather River Levee Repair Project, Segments 1 and 3 is to improve flood protection for the Reclamation District (RD) 784 service area in southwestern Yuba County. The specific project design objective is to provide increased flood protection to protect against the flood event with a 0.5 percent chance of occurrence in any given year (referred to herein as the 200-year flood event).

TRLIA has previously undertaken levee improvements for the Bear River, Western Pacific Interceptor Canal (WPIC), and Yuba River levees in RD 784. This report addresses strengthening of two segments of the Feather River left levee and a small portion of the Yuba River left levee at its junction with the Feather River levee in RD 784. For the purposes of discussion, the existing Feather River left levee between the Bear and Yuba Rivers and the portion of the Yuba River left levee considered in this report are divided into three segments. The approximate site location and limits of the segments are shown on Figure 1 and are defined as follows:

- Segment 1: Feather River left levee from the tie-in with the Bear River setback levee at Project Levee Mile 13.3 (PLM 13.3) to Star Bend (PLM 17.2), which corresponds to project Sta. 44+90 to Sta. 249+00. Segment 1 includes a portion of levee from about project Sta. 44+90 to Sta. 136+00 that is part of the U.S. Army Corps of Engineers (Corps) Site 7 Extension project.
- Segment 2: Feather River left levee from Star Bend (PLM 17.1) to about one mile north of Murphy Road (PLM 23.3), which corresponds to project Sta. 249+00 to Sta. 570+00.
- Segment 3: Feather River left levee from about one mile north of Murphy Road (PLM 23.3) to the Yuba River levee tie-in (PLM 26.1), and the Yuba River left levee from the tie-in with the Feather River levee (PLM 0.0) to the Union Pacific Railroad bridge just west of State Route 70 (PLM 0.3), which corresponds to project Sta. 570+00 to Sta. 724+00.

The proposed repairs address strengthening of Segment 1 and Segment 3 only. Modifications for Segment 2 will be addressed under TRLIA's next phase of levee repairs.

The proposed Project levee alteration entails constructing mitigation measures to repair seepage and structural deficiencies identified in levee Segments 1 and 3. In summary, the proposed repairs consist of the following:

Repairs to Correct Underseepage Potential

- Construct three segments of soil-cement-bentonite cutoff wall through the levee and its foundation, with combined length totaling approximately 11,500 linear feet.
- Construct one segment of soil-bentonite wall under the waterside toe of the levee, with a length of approximately 2,750 feet.
- Install 15 to 18 relief wells within the former Site 7 Extension.

Repairs to Correct Levee Through-seepage Potential

- Reconstruct two segments of the levee waterside slope with a low-permeability blanket, with total length of approximately 4,300 feet.
- Construct a stability berm against the levee landside slope, along a segment of the levee with length of approximately 2,600 feet.

Repairs to Reestablish Freeboard and Levee Cross-Section

- Flatten the waterside slope of the levee to the design slope of 3 horizontal to 1 vertical, along a reach of the levee with length of approximately 3,100 feet.
- Reshape the levee crown to correct sagging and reestablish freeboard along a reach totaling approximately 1,020 feet.
- Construct a flood gate at the crossing of the Yuba River levee with the Union Pacific Railroad, where a low area currently exists.

In addition to the proposed repairs, piezometers will be installed at six to eight locations to monitor seepage pressures at locations where the estimated seepage gradient is close to the allowable gradient and to monitor potential end-around seepage at cutoff walls.

The attached Table 1 provides a more detailed summary of the proposed levee repairs, locations of the various repair features, and depth of the proposed cutoff walls. Levee alterations will be designed to the 200-year flood event using current Corps design standards.

Public Interest Benefits

Benefits associated with the levee repairs include improved public safety and certification of the levees by Federal Emergency Management Agency (FEMA) for homeowners in RD 784 to qualify for preferred risk insurance policies under the National Flood Insurance Program (NFIP). The project will not increase downstream flow and stage during peak-flow conditions.

Because of unique topographical and meteorological features, the Feather-Yuba River basin is capable of producing significantly higher peak flood discharge per square mile of drainage area than any other major river basin in the United States. The 1986 flood, the largest flood ever recorded for the Feather River, triggered a major reevaluation of the federal flood control system by the Corps, which identified deficiencies in the flood control system protecting the Sacramento valley. Although a substantial flood risk reduction program has been undertaken since 1986, large portions of the Feather-Yuba area remain at high risk of flooding (having less than 100-year flood protection) or at moderate risk of flooding (having greater than 100-year but less than 200-year flood protection).

There is an immediate need to protect the people and property at risk in the project area. As specified above, the Feather and Yuba River levees protect a substantial amount of urban and agricultural development in the RD 784 service area, including over 40,000 current residents and structures with an estimated replacement value of approximately $2 billion. A breach of the Feather River levee would put most of these structures under five to ten feet or more of flood water, causing a loss of approximately 70 percent of the value of these structures in a single flood event. Based on current estimates of the likelihood of failure along this reach of the levee system, this equates to expected annual damages of approximately $25 million. Flooding would also result in releases of toxic and

hazardous materials (affecting downstream water supplies), groundwater contamination, and possible damage to the Marysville-Yuba City metropolitan power grid. The disruption in transportation that would result from a major flood would affect interstate railroads and state highways.

The project will help maximize public safety along the lower Feather and Yuba Rivers and their tributaries in the northern Sacramento valley. Specifically, the project will reduce the risk of flooding in a developed area with over 40,000 residents by addressing through-seepage and underseepage potential through construction of cutoff walls, berms, landside low-permeability blankets and relief wells along the existing Feather and Yuba River levees. This was determined to be the least damaging method of addressing the susceptibility of these levees to failure due to underseepage. The required construction activity will be conducted with minimal impact outside the existing levee right-of-way and without requiring fill or discharge into wetlands.

Relationship to Yuba River General Reevaluation Review and Potential 104 Credit
On July 5, 2005, the Assistant Secretary of the Army for Civil Works approved the Yuba County, California, application for credit under Section 104 of the Water Resources Development Act (WRDA) of 1986 for raising and strengthening the Western Pacific Interceptor Canal (WPIC) levee, strengthening one mile of the Yuba River levee, raising and strengthening two miles of the Bear River levee, and constructing a two-mile-long setback levee on the Bear River. The estimated cost of this effort was $59,900,000. The Corps is evaluating this work as part of the current General Reevaluation Review (GRR) study of the Yuba River Basin, California Project. One objective of this study is to determine if there is a Federal interest in the features being constructed by the TRLIA Project. Preliminary evaluations have already identified the same problems in the Feather and Yuba River levees that are being addressed by this alteration. The final remedies for these problems have not been selected or authorized. The GRR is scheduled to be complete in mid to late 2008.

2. PURPOSE/NEED FOR THE MODIFICATION

Yuba County has a long history of flooding. Floods in the Central Valley in 1986 and again in 1997 were catastrophic for Yuba County, inundating tens of thousands of acres, destroying thousands of homes and businesses, and causing loss of life, mostly within the Reclamation District (RD) 784 area. This area is bounded by the Yuba River on the north, the Feather River on the east, the Bear River on the south, and the Western Pacific Interceptor Canal on the west.

Two major flood protection improvement efforts resulted from the 1986 floods. First, the Corps and California Department of Water Resources (DWR) initiated the System Evaluation Project, which restored federally constructed levees in RD 784 to current design standards and reestablished the 1957 design top-of-levee profile. Most of the System Evaluation levee reconstruction work in RD 784 was completed in 1998. (Note that the 1997 floods resulted in the identification of additional levee seepage problems, which led to the Corps's System Evaluation Site 7 Extension project.) The second effort was Yuba County Water Agency's (YCWA's) initiation in 1988 of the Yuba Basin Project, which led to a Corps project designed to achieve what was then considered to be a "200-year" level of protection for RD 784 levees. The Yuba Basin Project was approved by Congress in 1998, and a construction start was authorized in 2002. In 2003, however, new Corps underseepage guidelines led to reevaluation of the project, which substantially increased the scope and estimated cost. Because of this cost increase, the Yuba Basin Project must be reauthorized by Congress. A General Reevaluation Report is currently being prepared to obtain a new project authorization and to initiate construction.

In response to the catastrophic flood of 1997, YCWA initiated a seven-phase program of flood control studies to identify methods to achieve a higher level of protection, particularly for the areas in RD 784 that had been subject to flooding several times in the past. The goal of this effort was to substantially improve the flood protection that would be provided by the System Evaluation Project and the Yuba Basin Project.

Following the passage of the Costa-Machado Water Act (Proposition 13) by California voters in 2000, YCWA's flood control study team turned the focus of its seven-phase program of studies to those measures that could be achieved within the budget provisions of Proposition 13, which provided for a total of $90 million in bond funds targeted for the Yuba-Feather River basin. As part of this effort, YCWA prepared a feasibility study that evaluated combinations of three flood control elements: an outlet capacity increase at New Bullards Bar Reservoir, forecast-coordinated operations of New Bullards Bar Reservoir and Lake Oroville, and a setback of the left bank levee of the Feather River between Shanghai Bend and the Bear River.

In May 2003, while YCWA was completing the first level of Yuba-Feather Supplemental Flood Control Project (Y-FSFCP) studies, the Corps, in a separate draft floodplain mapping study for DWR on the Feather River and its tributaries, identified several deficiencies in freeboard on the Bear River and WPIC levees that prevented these levees from meeting the Federal Emergency Management Agency (FEMA) criteria for providing protection for RD 784 from a "100-year" flood event. This information was unexpected by Yuba County officials because the 1998 Corps Yuba Basin study did not recommend any work for the WPIC and Bear River levees to achieve a 200-year level of protection for the RD 784 area. In addition, it was found that a 2,800-foot stretch of the Yuba River levee upstream of SR 70 did not meet slope stability requirements.

In 1993, following the initiation of the System Evaluation Project and the Yuba Basin Project, and before the most recent devastating flood (in 1997), Yuba County approved the Plumas Lake Specific Plan, which provides for a 12,000-home development on 5,200 acres in the southern portion of the RD 784 area. Development was initiated in the Plumas Lake Specific Plan area in 2002. The results of the 2003 Corps floodplain mapping study indicated that people and property in the RD 784 area, including homes that had already been built in the Plumas Lake Specific Plan area before the release of the Corps study, are subject to a much higher flood risk than previously believed.

Consequently, YCWA, RD 784, and Yuba County, in consultation with landowners and developers in RD 784, elected to move aggressively on a program to improve flood control for the RD 784 area. As a result, the Three Rivers Levee Improvement Authority (TRLIA), a joint powers authority composed of Yuba County and RD 784, was formed to focus on obtaining funding and implementing levee repairs for the RD 784 area. Additional problem identification studies were performed by TRLIA in 2004 and 2005 for the project levees surrounding RD 784. A problem identification study of the Feather River levee, completed in February 2006, identified significant seepage and structural deficiencies of the levee along most of its length between the Bear and Yuba Rivers. In addition, a moderate high-water event in early January 2006 reactivated historical boils along the Feather River levee that had been believed to be permanently repaired by construction measures undertaken by the Corps in 1997 following the 1997 Feather River levee break.

Based on the results of studies completed by TRLIA, RD 784, and others, the improvement program was planned to be implemented in four phases as follows:

- Phase 1: Implement improvements to the Yuba River levee between SR 70 and the UPRR at PLM 0.9.
- Phase 2: Implement improvements to the upper Bear River, WPIC, and Yuba (Between PLM 0.5 and 0.9) levees, modifications of RD 784 Pump Station No. 6, and construction of the Olivehurst Detention Basin.
- Phase 3: Construct a setback levee along the lower Bear River, tying into the Feather River levee just below Clark Slough.
- Phase 4: Strengthen the Feather River left bank levee between the mouth of the Yuba River and the Bear River setback levee constructed in Phase 3, and strengthen the Yuba River left bank levee below SR 70 and above the reach strengthened in Phases 1 and 2.

The following sections describe the condition of the existing Segment 1 and 3 levees and the proposed strengthening measures.

3. EXISTING PROJECT FACILITIES AND DEFICIENCIES

General Description

As shown on Figure 2, the Yuba and Feather River levees addressed by this project are located in RD 784 and are part of Unit No. 145 – Part No. 1 of the Sacramento River Flood Control Project, which comprises levees and channels in an area south of the City of Marysville and northwest of the Town of Wheatland. The approximate limits of the Feather and Yuba River identified as Segments 1 and 3 are shown on Figure 1. The existing flood control works being modified by the project include (1) the Feather River east levee from the tie-in with the Bear River north levee to Star Bend, (2) the Feather River east levee from the Yuba River south levee tie-in to a point about 3 miles south of the tie-in, and (3) the Yuba River south levee from the tie-in with the Feather River east levee to Union Pacific Railroad (UPRR) crossing west of highway S.R. 70. These levees provide direct protection to RD 784 against high water of the Feather and Yuba Rivers and their tributaries.

The majority of the subject levee is bordered on the landside by agricultural properties that typically maintain groves of fruit and nut trees. However, north of Feather River PLM 25.1 to Yuba River PLM 0.3 (UPRR crossing) numerous residential properties abut the landside toe of the levee. The waterside toe of the levee is generally undeveloped except for occasional groves of fruit and nut trees.

In general, the height of the existing levees ranges from about 15 to 30 feet with levee crown elevations varying from about 60 to 80 feet (NGVD) and landside toe elevations varying from 34 to 65 feet. The levee crown widths are typically about 20 feet, but are wider in some sections. The waterside slopes typically range from 3 to 5 (horizontal) to 1 (vertical), and the landside slopes typically range from 2 to 3 (horizontal) to 1 (vertical). A landside berm of variable height and width buttresses the levee along extensive portions of the alignment. The levee was constructed using primarily local soils from along the alignment. As a result, the embankment fill material in Segment 1 generally consists of clay and silt with some silty sand and clayey sand, and the fill material in Segment 3 generally consists of sand and silty to clayey sand.

Three main drainage pumping stations of RD 784 are located along the levee alignment. Surface drainage in the general project area is collected into ditches and canals where it is directed in the north to Pump Station No. 9, in the central portion to Pump Station No. 3, and in the south to Pump Station No. 2. Pump Station No. 9 is located near PLM 25.0 (Segment 3), Pump Station No. 3 is located at the end of Plumas Lake Canal above Star Bend near PLM 18.0 (Segment 2), and Pump Station No. 2 is located below Star Bend at the end of Clark Slough near PLM 13.4 (Segment 1). In addition to the pumps at Pump Station No. 2, drainage is provided by one gated box culvert that extends under the levee to allow gravity discharge of runoff and/or irrigation drainage to the Feather River when the river level is low.

Summary of Levee Construction History

Construction of the Feather River left levee, extending from the confluence with the Yuba River to the confluence with the Bear River, occurred in the early 1900s. The levee failed frequently prior to the 1930s, so in order to create a safer condition, the Corps set back a substantial portion of the levee and strengthened some reaches. Within Segments 1 and 3, levee strengthening was accomplished under the following contracts:

- Enlargement of the Feather River east levee from 2.8 miles south of Eliza Bend to mouth of Yuba River and south levee of Yuba River: Contract No. W-1105-eng-2762 by Caldwell Construction Company completed in November 1941.
- Enlargement of the Feather River east levee from 2-1/2 miles above Star Bend to Bear River: Contract No. W-1105-eng-2836 by Morrison-Knudsen Company completed in September 1941.

Since the 1941 strengthening, the Feather River east levee between Shanghai Bend and the Bear River confluence has experienced recurring, serious seepage problems during high river stages. Boils have been reported on the landside of the levee from about Murphy Road to south of Pump Station No. 2 near the end of Clark Slough. Major modifications, reconstructions, and upgrades have been implemented by the Corps over the years in response to deficiencies identified during flood events.

As a result of the 1986 flood and the failure of the south Yuba River levee near Linda, the Corps performed an extensive levee evaluation and reconstruction effort that began in the late 1980s and has continued for almost 20 years. The evaluation and reconstruction work, referred to as the Sacramento River Flood Control System Evaluation Phase II Project (abbreviated as "System Evaluation" or "Phase II"), was intended to restore the design level of flood protection provided by the levees. The Phase II work in Segments 1 and 3 consisted of the following:

Site 6 Cutoff Wall: A 50-foot-deep soil-cement-bentonite cutoff wall was constructed through the Feather River levee from PLM 25.1 (beginning at Island Avenue) to the end of the Feather River levee at PLM 26.1 and continuing as a 40-foot-deep soil-cement-bentonite cutoff wall through the Yuba River levee from PLM 0.0 to PLM 0.3 (about 35 feet downstream from the WPRR crossing).

Site 7 Levee Raising: The Feather River levee crest was re-established to its original grades from PLM 15.9 (below Star Bend) to about PLM 21.4 (north of Pearson Avenue). The height of levee crest raising reportedly ranged from several inches to several feet.

Site 7 Stability Berm: A 10-foot-wide by 7- to 9-foot-high landside stability berm and toe drain was installed between PLM 15.9 and PLM 16.6 south of Star Bend.

Site 7 Cutoff Wall: A 45- to 50-foot-deep soil-cement-bentonite cutoff wall installed through the levee crest along Feather River Boulevard, just downstream of Star Bend, between PLM 16.6 and 17.2.

Site 7 Extension Stability Berm, Seepage Berm, and Relief Wells: An area referred to as Site 7 Extension between PLM 13.2 and PLM 15.0, near RD 784's Pump Station No. 2, underwent construction of remedial seepage-control measures including: 1) 19 relief wells from PLM 13.3 to PLM 14.1, 2) a maintenance road, 3) concrete-lined drainage ditch to convey the relief well flow to Clark Slough, 4) relocation and complete reconstruction of Pump Station No. 2 about 150 feet to the east of its original location, 5) a 15-foot-wide, 12- to 14-foot-high landside stability berm from PLM 13.5 to PLM 14.6, and 6) a 100-foot-wide, 3- to 5-foot-high seepage berm from PLM 14.1 to PLM 15.0. The two berms overlap between about PLM 14.1 and PLM 14.6. The work in Site 7 Extension was completed in 2004.

In 1998 the Corps conducted a feasibility study to increase the level of flood protection to Yuba County. This project is referred to as the Yuba River Basin Investigation or, in short, the Yuba River Project. Additional improvements were planned to the existing levee system to raise the levee's Probable Non-failure Point (defined as the highest water level at which it is highly likely that the levee would not fail) and thus increase the level of flood protection. The work was planned to consist of extensions and/or additions to the System Evaluation reconstruction work. The authorized levee improvements are under re-evaluation and design by the Corps.

During a high water event in the first week of January 2006, a boil was observed in the intake channel at Pump Station No. 2, and two seeps were observed in a ditch adjacent to the levee downstream of the pump station. A portion of the relief well drainage ditch upstream of Pump Station No. 2 was damaged as a result of uplift. In response to the boil observed and damage that occurred in the January 2006 flood, the Corps repaired the relief well drainage ditch near

Pump Station No. 2 and installed four additional relief wells in the vicinity of the repaired ditch. Construction was completed in November 2006.

Existing Levee Deficiencies

Table 1 lists the areas of identified deficiencies. Based on available information, subsurface investigations, and levee evaluations performed for this project, the deficiencies requiring mitigation in reaches within levee Segments 1 and 3 are summarized as follows:

- Excessive underseepage pressures from the 100-year and 200-year flood events will result in unacceptable uplift and/or exit gradients (greater than 0.5) within the levee reaches listed in Table 1.
- Levee through-seepage may occur in embankment sections that were either constructed from or contain zones of pervious sandy soils that could allow internal erosion (piping) to occur or could cause embankment instability due to a raised phreatic surface.
- Freeboard for the 200-year storm event does not meet the minimum freeboard required by the Corps along a portion of the Yuba River levee within Segment 3.
- Along a reach of the Feather River levee within Segment 3 the waterside slope is steeper than allowed by the Corps for existing levee embankments.

4. SUMMARY OF ANALYSES AND EVALUATION CRITERIA

Design Process

TRLIA has engaged a team of consultants with a range of specialized expertise to implement the Phase 4 Feather River Levee Repair Project, Segments 1 and 3. The TRLIA team of consultants includes MBK Engineers; Bookman-Edmonston, a division of GEI Consultants (B-E/GEI); and Bender Rosenthal, Inc. MBK Engineers is performing program management and hydrology and hydraulics services; GEI is performing project management, design, and construction management services; and Bender Rosenthal, Inc. is performing right-of-way acquisition.

B-E/GEI retained the following specialty subconsultants for assistance with preparation of the design:

- EDAW Inc.: Environmental Studies, Permitting and Mitigation
- Phillip Williams Associates: Geomorphic Modeling
- MHM: Surveying and Mapping
- Prosonic Corporation: Geotechnical Field Explorations
- Taber Consultants: Geotechnical Field Explorations
- Vector Engineering: Geotechnical Laboratory Testing
- Cooper Testing Laboratory: Geotechnical Laboratory Testing
- PBS&J, Inc.: FEMA Certification Support
- Ford Engineering Consultants: Flood Control Benefit Analysis
- Mr. Kit Burton: RD 784 Interior Drainage Planning
- Mr. Donald H. Babbitt: Member, Board of Senior Consultants
- Dr. Faiz Makdisi: Member, Board of Senior Consultants

The goals of the design and construction process were stated as follows:

- Construct levee modifications that will meet Corps criteria and applicable State of California Water Code standards.
- Meet criteria for FEMA certification.
- Avoid or mitigate hydraulic impacts.
- Provide for crediting under a possible future Section 104 application.

B-E/GEI implemented a Quality Control Plan (QCP) to achieve these goals and assure that the analysis, design studies, and construction documents are of suitable technical caliber and quality, resulting in biddable, constructible, operable, and reliable facilities while minimizing construction costs. A Quality Control Team (QC Team) was assembled to review technical approaches and verify that deliverables and supporting documents prepared for the Phase 4 Feather River Levee Repair Project, Segments 1 and 3 are complete, conform to standards, and meet or exceed the expectations of TRLIA and the management of the B-E/GEI Team firms. The QC Team consisted of the following internal and external groups:

B-E/GEI Internal Quality Control Groups

- B-E/GEI Project Manager and Delivery Review Team (DRT)
- Internal Technical Review Team (ITRT)

External Quality Control Groups

- Board of Senior Consultants (BOSC)
- Quality Assurance Technical Oversight (QATO)

The members, roles, and tasks of each of the quality control groups are described in the following paragraphs.

B-E/GEI Project Manager and Delivery Review Team (DRT)

The Project Manager had the overall responsibility for the DRT design and quality control. The DRT members provided technical oversight as required during the design process and conducted detailed technical reviews of key deliverables. The DRT members consisted of staff with suitable experience and background to understand requirements for design analyses, drawings, specifications, cost estimates, and other deliverables to perform the detailed technical reviews. Design analyses, drawings, specifications, cost estimates, and other deliverables were checked and signed off by both the originator and the reviewers.

Internal Technical Review Team

The Internal Technical Review Team (ITRT) provided an independent review of project deliverables. B-E/GEI utilized the firm's in-house consultants and its senior sub consultants' capabilities and experience through periodic technical reviews supplemented with timely communication via internal meetings, telephone conference calls, and e-mails. Deliverables were reviewed to assure that the following objectives were met:

- The deliverables comply with standard engineering and professional practices.
- The scope of each deliverable is adequate.
- The data used are appropriate.
- The results are consistent and reasonable.
- The engineering concepts are valid.
- The engineering analyses have been checked by the DRT.

In addition, the ITRT reviewed pertinent deliverables from the perspective of FEMA certification requirements for the project.

Board of Senior Consultants (BOSC)

A two-member Board of Senior Consultants was assembled in coordination with TRLIA. Board members included Dr. Faiz Makdisi and Mr. Donald Babbitt, both recognized experts in flood control projects and geotechnical engineering. The BOSC provided TRLIA with independent reviews of engineering design and construction activities. Meetings were held with the BOSC to review work plans, Basis of Design Report (35% design submittal), and the 90% design drawings and technical specifications submittal. In advance of each meeting, the design team prepared an agenda with the

questions for which BOSC input was specifically requested, as well as supporting reports and meeting materials. Representatives of TRLIA, DWR, the USACE and the Reclamation Board were invited and participated in the BOSC meetings. At the conclusion of each meeting, the BOSC prepared a formal letter report, and the recommendations were addressed in the levee repair design.

Review by Corps, DWR and TRLIA: Quality Assurance Technical Oversight (QATO)
Representatives of the Design Branch and Geotechnical Branch Chiefs from the Sacramento District of the Corps, the designated Project Manager from Department of Water Resources (DWR), and the Design Manager from TRLIA were invited to review key submittals and verify that the designs and required submittals met applicable USACE and DWR standards and requirements. Their comments and recommendations were addressed in the levee repair design.

Design Documentation
A Draft Basis of Design Report was issued on August 11, 2006 to present the criteria to be used for the design of the levee repairs. A Draft Design Report was issued in January 2007 that encompassed and expanded the August 11, 2006, Draft Basis of Design Report by including not only the basis and criteria to be used for the design but also the results of the analyses and design evaluations performed until that date, and the details of the levee repair design. Comments on the Draft Basis of Design Report were addressed and incorporated in the Draft Design Report. Comments received on the Draft Design Report through March 28, 2007, were addressed and incorporated in a subsequent issue of the Design Report, entitled Issued for Approval Design Report, dated March 2007. The Quality Control Record, including the comments and the response documents, was included in Appendix H to the March 2007 Design Report.

Sources of Design Criteria
This section describes the key state and federal standards of the agencies with regulatory authority over the project.

California Reclamation Board
The Reclamation Board has primary state jurisdiction for approval of levee design and construction. Primary standards that control the design of the levee repairs are found in California Code of Regulations (CCR), Title 23, Division 1, Article 8 (Sections 111 through 137).

U.S. Army Corps of Engineers
The Corps has federal jurisdiction of approval of SRFCP levee design and construction. The design of the levee repairs was in accordance with the following primary federal standards:

- Engineer Manual EM 1110-2-1913, *Design and Construction of Levees*, 30 April 2000.
- Engineer Manual EM 1110-2-1914, *Design, Construction and Maintenance of Relief Wells*, 29 May 1992.
- SOP EDG-03, *Geotechnical Levee Practice,* CESPK-ED-G, 7 July, 2004.

In addition, the following Corps documents contain guidance applicable to the levee strengthening:

- Engineering Technical Letter ETL 1110-2-569, *Design Guidance for Levee Underseepage*, 1 May 2005.
- Engineer Manual 1110-2-1100, *Coastal Engineering Manual, July 2003.*
- Engineer Manual 1110-2-1420, *Hydrologic Engineering Requirements for Reservoirs*, 31 October 1997.
- Engineer Manual 1110-2-1614, *Design of Coastal Revetments, Seawalls, and Bulkheads*, 30 June 1995.
- Engineer Manual 1110-1-1804, *Geotechnical Investigations*, 01 January 2001.
- Engineer Manual 1110-2-1902, *Slope Stability*, 31 October 2003.
- Engineer Manual 1110-1-1904, *Settlement Analysis*, 30 September 1990.

- 2003 CESPK Levee Task Force, *Recommendations for Seepage Design Criteria, Evaluation and Design Practices*, 15 July 2003.
- Engineer Manual EM 1110-2-301, *Guidelines for Landscape Planting at Floodwalls, Levees, and Embankment Dams*, 1 January 2000.
- Engineer Manual EM 1110-2-1601, *Hydraulic Design of Flood Control Channels*, 30 June 1994.
- Engineering Technical Letter ETL 110-1-185, *Guidelines on Ground Improvement for Structures and Facilities*, 01 February 1999.
- Engineering Technical Letter ETL 1110-2-299, *Overtopping of Flood Control Levees and Floodwalls*, 22 August 1986.
- U.S. Army Costal Engineering Research Center, *Shore Protection Manual*, 1984.

Federal Emergency Management Agency

One of the key goals of the project is to obtain levee certification for Federal Emergency Management Agency (FEMA) floodplain mapping. FEMA design criteria for levees were obtained from Section 65.10 of the National Flood Insurance Program regulations (44CFR Ch. I, Section 65.10). The design criteria include requirements for freeboard, closure devices for openings, embankment protection, embankment and foundation stability, settlement, and interior drainage.

Specific Design Criteria and Analyses

The standards enumerated above prescribe minimum freeboard, minimum levee cross-sectional dimensions, underseepage control, construction material types, compaction levels, easement widths, foundation treatment, etc. These requirements form the basis of the levee repair design and are summarized below.

Hydraulics and Hydraulic Analysis

The design flood is the 0.5 percent (or one-in-200) annual chance flood (200-yr) event developed by the Corps. The 1 percent (or one-in-100) annual chance flood (100-yr) was also modeled to demonstrate compliance with FEMA requirements. The hydraulic model used in the analysis was calibrated to the January 1997 flood event. Details of the hydraulic analysis are presented in Appendix A of the Design Report, *Hydraulic and Hydrologic Documentation for FEMA Certification of the Three Rivers Levee Improvement Authority Project*. The results of the hydraulic analysis were reviewed and coordinated with hydraulic engineers of the Corps' Sacramento District. The water surface profiles are shown on Figures 3 and 4 for the Feather River and lower Yuba River, respectively.

Freeboard

The strictest of the following freeboard requirements was applied at each section of the levee to verify the crown elevation:

- Project Objective: Three feet of freeboard above the one-in-200 annual chance flood profile.
- FEMA: Three feet above the one-in-100 annual chance flood profile. An additional one foot above the minimum was required within 100 feet in either side of the Union Pacific railroad bridge at the upstream end of the project.

In addition, the freeboard was verified to completely contain computed wave runup for the one-in-100 annual chance flood and to substantially contain the wave runup for the one-in-200 annual chance flood event. For the one-in-200 annual chance flood, minor wave wash over the levee crown (defined as less than 1.5 feet of computed wave runup above the crown centerline for waves generated during the peak wind assumed to occur concurrently with the peak flood stage) at the maximum flood stage was considered acceptable given the conservatism of the analysis, the wide crown, and gravel patrol road surfacing provided. The details of the assessment of wave runup and wind setup are presented in Section 4.3 and Appendix E of the Design Report, *Analysis of Wave-Driven Erosion, Wind Setup and Wave Runup, Feather River Levee Repair Project.*

The freeboard also accounted for future levee settlement where berms are used as strengthening measures. Levee settlement due to embankment compression and foundation consolidation was estimated using methods described in EM 1110-1-1904. Levee settlement due to embankment compression and foundation consolidation was estimated as described in Section 4 and Appendix G of the Design Report, *Stability and Settlement Calculations*.

Minimum Cross-Section Dimensions and Slopes

The minimum dimensions of the setback levee, as required by SOP-EDG-03, are summarized below:

- Crown Width: nominal 20 feet (as measured at the level of the design river stage plus required 3-foot freeboard)
- Patrol Road Width (on Crown): 12 feet
- Waterside Slope: 3H:1V
- Landside Slope: 2H:1V for existing levee section (provided landside slope performance has been good)

Stability

Stability of the embankment cross-section (both landside and waterside slopes) was verified for steady-state seepage, rapid-drawdown, and end-of-construction (only where a new berm or embankment raise is planned) stability cases. The required minimum safety factors are detailed in EM 1110-2-1913, Table 6-1b. Detailed confirmatory slope stability analyses were performed for the range of foundation materials and embankment cross sections identified by field investigations and using site-specific strength properties for foundation and embankment materials. Details of the stability analyses are summarized in Section 4 of the Design Report and the results of the analyses are provided in Appendix G of the Design Report, *Stability and Settlement Calculations*. The analyses confirmed that, after the mitigation measures for underseepage and through-seepage are implemented, the existing levee meets or exceeds the required minimum safety factors detailed in EM 1110-2-1913, *Design and Construction of Levees*, Table 6-1b.

Levee Embankment Materials

In general, use of "impervious" material has been specified for construction of levee modifications in accordance with Reclamation Board and Corps requirements. This material is defined as soil having 20 percent or more passing the No. 200 sieve, with a plasticity index of 8 or more and a liquid limit less than 50, and free of lumps or stones exceeding three inches, vegetative matter, or other unsatisfactory materials. The embankment material is to be compacted to a minimum density of 95 percent of maximum laboratory dry density determined by ASTM Method D698 with an allowable range in placement moisture contents of -2 to +2 percent of optimum moisture content. The levee crown roadway and access ramps will be surfaced with a minimum of four inches of Class 2 aggregate base and compacted to a minimum of 95 percent of maximum laboratory dry density per ASTM Method D1557.

Erosion Protection

FEMA requires that the design of the levee demonstrate that no appreciable erosion of the levee embankment can be expected during the 1 percent annual chance of exceedance flood event, as a result of either currents or waves. In addition, project criteria require that anticipated erosion from the 0.5 percent annual chance of exceedance flood event should not result in failure of the levee embankment or foundation directly or indirectly.

The levee erosion potential was evaluated based on performance history for the existing levee during major flood events such as the January 1997 flood, the documented evolution of active erosion sites, the anticipated design water velocities, wave-induced water velocities, embankment side slopes, soil characteristics, and channel sinuosity and uniformity. Criteria for maximum permissible water velocities are adopted from Corps' guidelines for the design of flood control channels (EM 1110-2-1601).

In reaches of the existing levee that are determined to be susceptible to erosion, and along all reconstructed embankment, the levee slopes will be seeded with approved non-woody ground cover for erosion protection. Criteria regarding vegetation on levee slopes are contained in Section 131 of the CCR.

A preliminary evaluation of erosion features along the Feather River east levee is presented in Appendix B of the Design Report, *Three Rivers Levee Improvement Authority Phase 4 Erosion Investigation*, and the details of the analysis of wave-driven erosion, wind setup and wave runup are presented in Appendix E of the Design Report, *Analysis of Wave-Driven Erosion, Wind Setup and Wave Runup*. Additional hydraulic modeling of the design conditions will be conducted after the work identified in this report is completed. Water velocities along the levee will be computed using a 2-D hydraulic analysis for the 1:200 annual exceedance probability flood event. If required based on the 2-D hydraulic analysis, erosion protection will be installed during later phases of work or the monitoring approach will be refined or modified as appropriate.

Foundation Stripping

All areas to receive fill are specified to have surface vegetation and organic soil removed to a minimum depth of six inches. Trees removed from the berm foundation area will have their root systems removed. Roots greater than 1.5 inches will be removed to a depth of three feet as a minimum. All drains, ditches and abandoned conduits will be removed from the berm foundation and backfilled with low-permeability soil.

Trees removed from the floodway also will have their root systems removed. All voids created by tree removal will be backfilled and compacted to at least the density of the adjacent, firm, undisturbed material.

Foundation Seepage Analysis and Control

Seepage analysis of the levee foundation was based on the assumption that steady-state conditions have developed for the peak stage of the design flood event. Seepage analyses computed the distribution of hydraulic heads within the levee foundation, both in the pervious strata as well as in the less pervious upper stratum on which the levee is founded. The need for seepage control measures was triggered by (1) an uplift gradient (defined as the difference in hydraulic head across the less pervious upper layer divided by the layer's thickness) in excess of 0.5, and/or (2) an exit gradient in excess of 0.5, both computed with water at the design water surface elevation. The detailed methodology and results of the seepage analysis are described in Section 4 of the Design Report and Appendix F, *Seepage Calculations*.

Easements

Easements along the landside and waterside levee toes are necessary for maintenance, inspection, and flood-fight access (landside toe only). The availability of access along the levee toes has been evaluated. Easements have been obtained for berms needed along the levee toe, and temporary construction easements have been obtained for temporary construction access and staging areas.

The Reclamation Board prescribes that the areas adjacent to the toe of the levee slopes must drain away from the levee for a minimum distance of ten feet. Agricultural ditches, power poles, standpipes, distribution boxes, and any other aboveground structures, must be situated outside the toe easement. Any new pipelines running parallel to the levee alignment should also be located a minimum distance of 20 feet beyond the levee toes and buried no deeper than five feet. At locations where a drainage ditch or other seepage control facility is provided landside of the levee, the appropriate right-of-way for the feature must be included in the levee corridor. All pipe, conduit, or power line being installed in the levee section and/or within the levee toe easements will meet Title 23 standards.

Additional Geometric Requirements

Ditches, ponds, and other excavations will be located a safe distance from the levee as determined by the results of seepage and slope stability analyses, using a threshold exit gradient of 0.5. As a standard, ditches and other excavations will be located a distance of at least 50 feet and 10 times their depth from the landside levee toe.

Borrow Areas

Borrow areas were designed to provide necessary quality and quantity of materials. Borrow areas will be planned in accordance with guidelines in Chapter 4 of EM 1110-2-1913, *Design and Construction of Levees.*

Seismic Considerations

The unconsolidated sediments on which the proposed levees will be founded include layers of soft cohesive soils and loose cohesionless soils. Some of these materials, where saturated, could experience a reduction in strength during and immediately following strong earthquake shaking (a phenomenon referred to as soil liquefaction). Liquefaction of foundation soils could induce damaging settlement and/or displacements of the overlying levee structure. While this situation is possible, the combined probability of strong ground motion occurring during or just prior to high river levels is extremely low. Because of this low probability, the current standards of design do not require that earthquake loadings be included in stability analyses performed for levees that do not retain a permanent pool. Liquefaction effects, should they occur, can be repaired following an unlikely event of strong earthquake shaking.

The potential for earthquake damage of levees, however, should be considered in planning efforts by RD 784 and Yuba County. Earthquake emergency response planning should address levee rehabilitation requirements, such as urgency of repairs, availability of local contractors and heavy equipment, and sources for essential reconstruction materials and services. Liquefaction damage, should it occur in the unlikely event of strong earthquake shaking, would need to be repaired as soon as practicable in order to restore levees to appropriate safety prior to the next flood event. The maintenance plan and inspection protocol will be reviewed to make sure that adequate provisions exist to identify earthquake damage and to mitigate damage. Any appropriate changes to inspection and monitoring protocols will be identified.

Interior Drainage

The proposed repairs will not reduce the storage capacity of low-lying areas within RD784 and will not impact existing drainage ditches and laterals. Therefore, the interior drainage will not be impacted by the levee repair project.

Abandonment or Relocation of Utilities

The design for abandonment and/or relocation of utilities follows design criteria applicable to each specific utility and Title 23 standards within the levee right-of-way. Modifications to power distribution lines and gas mains, if needed, will be in accordance with Pacific Gas & Electric Company criteria. Destruction of existing wells and installation of new wells, if any are required, will meet the requirements of Bulletin 74-81, *Water Well Standards: State of California*, and Bulletin 74-90, *California Well Standards.*

Modifications of irrigation systems within affected areas (such as if any irrigated areas are impacted by construction of seepage berms), will be made in coordination with the respective landowners according to their requirements.

Closures

FEMA requires that all openings through a levee be provided with closure devices that are structural parts of the system and designed according to sound engineering practice. Existing and planned closures are listed below:

- A new closure will be constructed at the Union Pacific Railroad (formerly Western Pacific Railroad) where it crosses the Yuba River left levee at the northern end of Segment 3.
- An existing closure at Pump Station No. 2 was constructed in 2004 and meets FEMA requirements.
- An existing closure consisting of the outfall pipe for the Linda County Water District Wastewater Treatment Plant will be removed and reconstructed in compliance with FEMA and Title 23 requirements as part of this project.

5. PROPOSED MODIFICATIONS

This section summarizes the proposed levee modifications to correct the deficiencies identified in Section 3. Table 1 summarizes the areas of identified deficiencies and the proposed modifications or mitigation measures. The attached Drawing G-4 shows the approximate limits of proposed modifications in plan.

Cutoff Walls

The installation of cutoff walls is planned to control underseepage where relatively shallow strata of permeable sands and gravels exist in the foundation soils and to control through-seepage in areas where the existing levee embankment is constructed from pervious, sandy soils. As an alternative to cutoff walls, the use of seepage berms was evaluated to control underseepage gradients. However, the use of seepage berms was found to not be cost-effective due to high land acquisition costs for seepage berm construction. The use of relief wells is another alternative means to control underseepage and is proposed for use in one reach of the levee where the infrastructure needed for collecting, conveying and disposing of water discharging from the relief wells is already in place.

Low permeability waterside blankets and stability berms were evaluated as alternatives to cutoff walls for controlling through-seepage. In cases where only through-seepage cutoff is required, it was concluded that stability berm or waterside blanket construction would generally be more cost effective. Therefore, the use of cutoff walls has been reserved for cases where the potential for underseepage, or both under- and through-seepage, requires mitigation.

Cutoff walls are designed to dissipate hydraulic gradients in the levee embankment and foundation and to reduce seepage pressures and quantities to safe levels. To achieve maximum effectiveness, the cutoff wall must extend completely through the permeable strata and terminate some distance into an underlying, reasonably continuous, lower-permeability layer.

Cutoff walls will be constructed using slurry techniques with long-stick backhoes and will generally be soil-cement-bentonite walls constructed through the embankment. However, in one reach, the required wall depth is difficult to reach from the top of the levee using the long-stick backhoe method, and there is already an existing cutoff wall through the embankment that prevents seepage through the levee. For this reach of the levee, the cutoff wall will be a soil-bentonite wall constructed through the waterside toe of the embankment.

For walls constructed through the embankment, the soil-cement-bentonite fill is required to maintain embankment stability, but for the toe cutoff wall, the wall is constructed beneath the embankment and the additional strength provided by the cement is not required. Thus, the soil bentonite backfill is suitable for the proposed toe cutoff wall.

Construction of each cutoff wall will consist of first excavating, or "degrading," a portion of the embankment to form a suitable working surface. The cutoff wall will then be constructed to the required depth from the working surface. Once the cutoff wall is completed, a permanent cap will be placed over the top of the cutoff wall, and the embankment will be reconstructed. Details for cutoff wall construction are shown on attached Drawings C-40, C-41, and C-42.

Relief Wells

Relief wells are another means of providing a controlled seepage path for reduction of water pressure in the foundation soils. Relief wells, however, can be prone to plugging and damage from vandalism and require operation (water removal) and periodic maintenance (flushing, cleaning, and replacement) to remain effective. Therefore, use of relief wells was only considered in areas where water removal infrastructure (ditches, pumps, etc.) is already in place or where other measures are deemed to be insufficient or impractical. Monitoring of the relief wells and levee foundation conditions during flood events will be included in the Operation and Maintenance Plan addendum.

Stability Berm

Cutoff of through-seepage is required in areas where the embankment is constructed from or contains significant zones of pervious sandy soils. Cutoff of through-seepage is important to prevent a high phreatic surface from developing through the embankment and daylighting on the landside slope because a high phreatic surface within the embankment would reduce embankment stability. Because its main purpose is to increase embankment stability, a landside berm constructed to mitigate through-seepage is referred to as a stability berm. Details of the proposed stability berm are shown on attached Drawing C-43. A filtered drain is provided to intercept and filter through-seepage to prevent piping, and the mass of the berm is provided to increase embankment stability. The elevation of the top of the stability berm approximately corresponds to the 1:200 annual chance flood water surface. The minimum berm width was generally selected based on constructibility considerations.

Waterside Blankets

A waterside blanket is an alternative means of controlling seepage through a levee. The waterside slope of the levee is excavated and reconstructed using low permeability fill to reduce water infiltration during flood events. Details of the proposed waterside blankets are shown on attached Drawing C-44. Waterside blankets were evaluated in lieu of stability berms in areas where only through-seepage mitigation is required. In addition to controlling through seepage, landside stability berms buttress the embankment and significantly increase the embankment stability. Thus, in principle, stability berms are preferred. As a result, waterside blankets were only used in areas where a low landside stability berm already exists but is not high enough to control through-seepage for the design water surface.

Piezometers

Vibrating wire piezometers will be installed to measure seepage pressures in the pervious strata at the landside toe of the levee in reaches of levee where underseepage analyses indicate that seepage gradients are at or near the allowable gradient of 0.5 and in areas where potential cutoff wall end-around seepage could potentially occur. Piezometric elevations will be measured during flood events to confirm that the resulting seepage gradients are not higher than allowable values. Requirements for monitoring the piezometers and action levels will be included in the Operation and Maintenance Manual addendum.

Open standpipe piezometers and traditional monitoring wells were considered for this application. However, at moderate to high flood levels, the estimated piezometric elevation at the landside toe of the levee is above the ground surface elevation, and water would flow out of the well or piezometer impeding measurement of the piezometric level. To provide confirmatory measurements at low piezometric levels, open standpipe piezometers will be installed near several vibrating wire piezometers.

Crown Reshaping
Levee crown surveys have revealed minor freeboard deficiencies in a reach of the existing levee. Minor crown reshaping will be performed as shown on attached Drawing C-45.

Slope Flattening
At a reach of the levee where the waterside slope is significantly steeper than 3H: 1V, the slope will be flattened. Typical slope flattening details are shown on attached Drawing C-44.

Closure Structure
At the Union Pacific Railroad (UPRR) crossing of the Yuba River levee there is a freeboard deficit, but it is impractical to raise the elevation of the railroad. As a result, a flood control gate is proposed for the 200-year storm event.

Utility Crossings
An existing utility crossing consisting of the outfall pipe for the Linda County Water District Wastewater Treatment Plant will be removed and reconstructed in compliance with FEMA and Title 23 requirements as part of this project.

The crossing of the Plumas Mutual Water Company irrigation pipelines will also be removed and reconstructed in compliance with FEMA and Title 23 requirements.

Pipes currently known to exist in an abandoned condition (completely or partially grouted) through or under the levee will be excavated and removed, and the levee will be reconstructed in compliance with Corps and Title 23 criteria.

6. LOCAL AND SYSTEMWIDE HYDRAULIC EFFECTS OF THE LEVEE MODIFICATION

Modeling of Hydraulic Effects
Any potential impacts of the alteration were evaluated using state-of-the-art hydraulic models and hydrology data obtained from the Corps. The hydrologic and hydraulic models used for this study are described in the MBK Engineers report titled *Hydraulic and Hydrologic Documentation for FEMA Certification of the Three River's Levee Improvement Authority Project*, dated March 2007 (included as Appendix A of the Design Report). The 1-in-100 and 1-in-200 AEP floods were routed through Lake Oroville and New Bullards Bar Reservoir for hypothetical storms centered over either the Feather River or Yuba River watershed. The resultant flows were routed through the flood system down to the location of Verona, on the Sacramento River immediately downstream of the confluence with the Feather River. Water surface profiles were calculated for each flood event. The Shanghai-Yuba centering (i.e., location in the hydrologic model where a storm is focused) provided the highest water surface elevations along the Feather and Yuba Rivers and also along the lower Bear River. The water surface profiles were calculated based on an assumption that levees would overtop but would not fail. This assumption ensures the worst-case (highest) water surface profile for any given flood. This is also the condition that the downstream levee system has a reasonable probability of experiencing during an extreme flood because levees are not designed to fail for a water surface elevation lower than the top of the levee. The proposed alteration strengthens the levee in place for Segments 1 and 3 and does not change the existing levee alignment and the existing floodway is not widened.

Local Hydraulic Effects and Downstream Hydraulic Impacts and Mitigation
Because the proposed alteration does not include a setback levee and associated floodway expansion, but rather results in a continuation of the existing levee configuration in the project area, there are no hydraulic impacts associated with the alteration. This alteration would not result in any long-term changes to the existing drainage pattern of the project site, would not affect the rate or amount of surface runoff in the project area, would not increase exposure of persons or private property to flood hazards, and would not reduce water supply or alter regional or local hydrology. The alteration also would not affect the operation or risk of failure of upstream dams (i.e., Lake Oroville

and New Bullards Bar Reservoir). Therefore, impacts would not occur under the proposed alteration and no additional discussion is required.

7. NEPA DOCUMENTATION; COMPLIANCE WITH CEQA

NEPA documentation for the Corps of Engineers' approval of alteration to Federal Project levees in connection with TRLIA's Feather River Levee Repair Project, Segments 1 and 3 (Proposed Project) already exists, in the form of the April 1998 Final Environmental Impact Statement/Environmental Impact Report (FEIS/EIR) prepared by the Corps (together with the California State Reclamation Board as non-federal sponsor) for the Yuba River Basin Investigation (1998 Yuba River Project). Specifically, the second and third alternatives considered in the 1998 FEIS/EIR involved essentially the same repairs to the same reaches of Federal Project levees along the Yuba and Feather Rivers as are involved in the Proposed Project that the Corps is being asked to process under section 408.[1] The third alternative was the recommended and authorized plan from that analysis. Additionally, the environmental setting in which these repairs will occur has not significantly changed.

The 1998 FEIS/EIR concluded that "most adverse effects on environmental resources in the project areas would either be short term or would be avoided using best management practices," and the FEIS proposed mitigation measures to reduce the remaining effects (on vegetation and wildlife and special status species) to less-than-significant. (P. S-5). TRLIA has incorporated those mitigation measures into the Proposed Project.

Under these circumstances, the Corps has two procedural avenues open to it under NEPA, neither of which requires further environmental analysis.

First, application of established guidance from the Council on Environmental Quality would allow the Corps to conclude that the 1998 FEIS/EIR is adequate for its decision-making respecting the Proposed Project and that a supplement is not required (see 40 C.F.R. §1502.9(c); CEQ, Forty Most Asked Questions, number 32). In conjunction with this conclusion, the Corps should carefully re-examine the 1998 FEIS/EIR to document for the administrative record that fact that the FEIS/EIR indeed covers the actions being proposed for Corps approval. Because the 1998 FEIS/EIR is fully sufficient, no additional public review or comment is necessary.

Second, and alternatively, the Corps could utilize the November 2006 Final Environmental Impact Report (FEIR) prepared by TRLIA under CEQA for the Proposed Project,2 prepare an Environmental Assessment based on it,3 and issue a Finding of No Significant Impact (FONSI). In this connection, it should be noted that the 2006 FEIR reached essentially the same conclusions as did the 1998 FEIS/EIR respecting the absence of significant environmental impacts: While the Proposed Project "could significantly affect a number of environmental resources, mainly during construction of project features, mitigation is included and that would ensure the reduction of most of these impacts to a less-than-significant level. In addition, the three project alternatives have the potential to provide a substantial reduction of flood risk in the RD 784 area." DEIR, (P. 1.5). Important here is that the impacts found significant and unavoidable were the loss of farmland associated with levee relocation and construction of certain additional facilities, actions that are not part of the Proposed Project the Corps is being asked to approve.

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[1] The FEIS described the proposed action as follows: "[I]ncrease flood protection to the lower Yuba River basin, part of the Feather River basin below Oroville Dam, and the City of Marysville by (1) raising levees, constructing or modifying berms and drains, and installing or modifying slurry walls along sections of the Yuba and Feather Rivers and (2) installing slurry walls along the ring levee around the City of Marysville."

[2] Final Environmental Impact Report for the Feather River Levee Repair Project, an Element of the Yuba-Feather Supplemental Flood Control Project. Prepared for TRLIA by EDAW Flood Control Study Team. State Clearinghouse No. 2006062071. November 2006.

[3] Note that under the Corps regulations, 33 C.F.R. §230.6, an EIS is normally required for "proposed changes in projects which increase size substantially or add additional purposes." What is proposed here is in-place repair and strengthening of existing levees.

The Corps utilized the EA/FONSI approach when it issued a 2005 individual permit under section 404 of the Clean Water Act for the first stage of construction of the setback levee in the Feather-Bear Rivers Levee Project based on the FEIR prepared for that project under CEQA by TRLIA. If the Corps were to take this approach with respect to this Proposed Project, no CEQ or Corps regulation would require the Corps to seek additional public review or comment.4 The only requirement would be that the Corps make the FONSI available to the public

Since certification of the EIR, a wetland delineation has been completed in the area proposed for levee repairs in project Segments 1 and 3 and coordination with state and federal resource agencies has been conducted. Based on the wetland delineation, the project design, field reviews of the project site, and coordination with state and federal resource agencies, it has been determined that proposed levee repairs in Segments 1 and 3 will have no effects on wetlands and waters of the U.S., cultural resources, threatened and endangered species, or other protected resources.

TRLIA has provided the 1998 FEIS/EIR, the 2006 FEIR, the wetland delineation report, and all studies underlying these documents to the Corps.

8. STUDIES IN SUPPORT OF THE PHASE 4 FEATHER RIVER LEVEE REPAIR PROJECT, SEGMENTS 1 AND 3

The following is a summary of documents that directly support the levee repair design. Unless otherwise noted, copies of these documents have been provided to the Corps Sacramento District.

- GEI, Construction Drawings and Specifications, Phase 4 Feather River Levee Repair, Issued for Bid, March 2007 – Drawings and specifications governing construction of the levee repairs and ancillary features.

- GEI, Phase 4 Feather River Levee Repair Project, Design Report, dated March 2007. Identifies the standards used in the design, describes the design assumptions and design criteria, summarizes the methods and results of the hydraulic and geotechnical analyses, and describes the key features of the proposed repairs. Includes hydraulic and hydrologic analysis, analysis of wave-driven erosion, seepage calculations, stability calculations, settlement calculations, and responses to comments on the levee repair design received through March 28, 2007.

- MBK Engineers, Hydraulic and Hydrologic Documentation for FEMA Certification of the Three River's Levee Improvement Authority Project, dated March 2007. This report is included as Appendix A of the Design Report.

- MBK Engineers, Three Rivers Levee Improvement Authority Phase 4 Erosion Investigation, dated February 2006. This report is included as Appendix B of the Design Report.

- GEI, Phase 4 Feather River Levee Repair Project, Geotechnical Data Report, dated January 2007, and Addendum No. 1, dated March 2007. This report contains the available geotechnical data along the existing levee alignment.

- GEI, Phase 4 Feather River Levee Repair Project Alternatives Analysis Report, dated December 2006. This report contains cost and benefit evaluations of TRLIA's levee repair program.

[4] It should be noted that in preparing its FEIR, TRLIA engaged in formal public scoping and circulated the Draft EIR for public comment before preparing the FEIR.

- GEI Phase 4 Feather River Levee Repair Project, Phase 1 Environmental Site Assessment, Project Segments 1 and 3, dated January 2007. The report identifies whether hazardous substances are likely present at the site.

- Kleinfelder, Problem Identification Report, dated February 20, 2006. This report contains the results of preliminary investigations and provides preliminary repair recommendations for the sections of levee discussed in the Design Report.

- EDAW, Environmental Impact Report for the Feather River Levee Repair Project, an Element of the Yuba-Feather Supplemental Flood Control Project, (Draft EIR dated August 2006, Final EIR dated November 2006). This is the California Environmental Quality Act (CEQA) compliance document for the Feather River Levee Repair Project

- Philip Williams & Associates, Geomorphic Assessment of Project Alternatives for Feather River Levee Improvements Between the Bear and Yuba Rivers, January 2007.

- All studies cited in the 1998 FEIS/EIR and in the wetland delineation report.

Attachments

Table 1

Figures 1 through 4

Drawing G-4

Drawings C-40 through C-45

Table 1 - Levee Repair Measures
Phase 4 Feather River Levee Repair Project
Reclamation District No. 784
Yuba County, California

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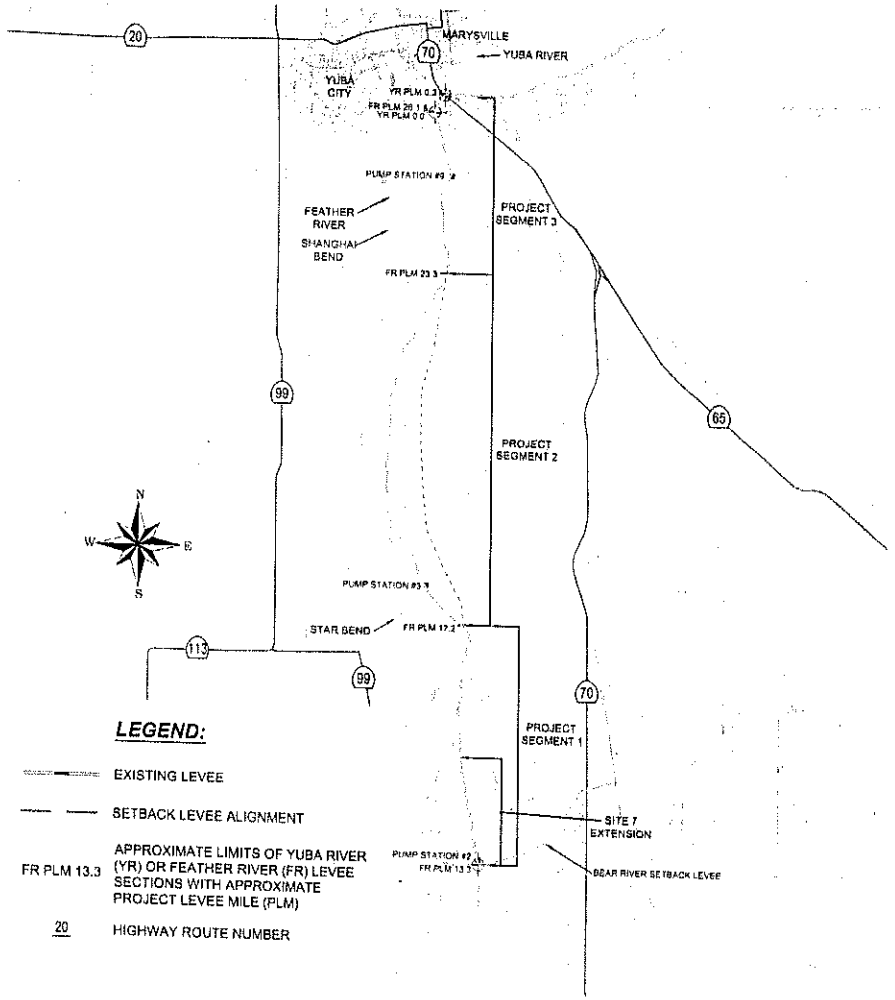
Revision 4/13/07

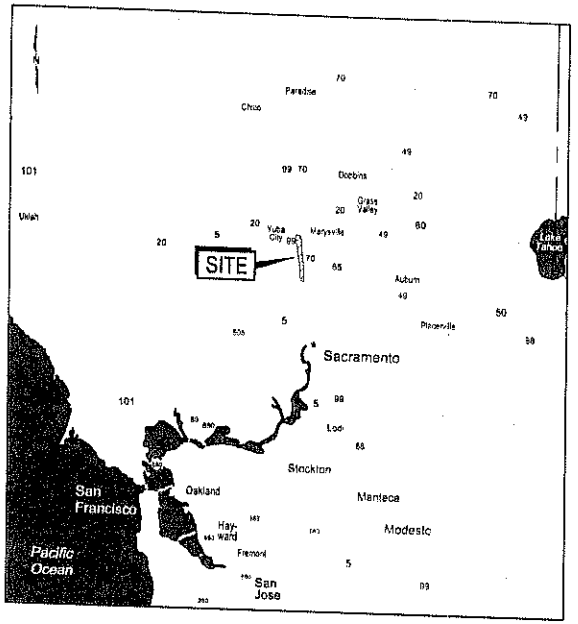
Design Section	Levee Segment	Design Section Limits	PIR Section	Problem Identified	Planned Repair Measure
1	1	Sta. 44+90 to Sta. 88+50	1A	Through-Seepage & Underseepage	(Option in Contract - Work May Be Performed by Corps) Sta 46+87 - 86+83: Relief wells split-spacing the existing wells Sta 78+00 - 88+50: low permeabillity waterside blanket from crown to top of drain in existing landside stability berm
2	1	Sta. 88+50 to Sta. 112+00	1B	Through-Seepage Only	(Option in Contract - Work May Be Performed by Corps) Sta 88+50 - 104+00: low permeabillity waterside blanket from crown to top of drain in existing landside stability berm Sta 104+00: Install piezometer
3	1	Sta. 112+00 to Sta. 126+00	1B	None	No work
4	1	Sta. 126+00 to Sta. 166+50	1B/ 2	Through-Seepage & Underseepage	Sta. 126+00 - 135+00: no work Sta. 135+00 - 139+00: cutoff wall through embankment to El. 10 (~50 ft)+G12 Sta. 139+00 - 147+00: cutoff wall through embankment to El. 0 (~65 ft) Sta. 147+00 - 157+00: cutoff wall through embankment to El. 8 (~55 ft) Sta. 157+00 - 162+00: cutoff wall through embankment to El. 4 (~60 ft) Sta. 162+00 - 166+50: cutoff wall through embankment to El. 35 (~30 ft)
5	1	Sta. 166+50 to Sta. 182+00	2	None	Sta. 166+50 - 182+00: No Work Sta 178+50: Install piezometer (inc. open standpipe)
6	1	Sta. 182+00 to Sta. 212+00	3	Through-Seepage & Underseepage	Sta 182+00 - 199+00: low permeabillity waterside blanket from crown to top of drain in existing landside stability berm Sta. 198+00 - 212-00: cutoff wall through embankment to El. 20 (~45')
7	1	Sta. 212+00 to Sta. 221+50	3/ 4A	Through-Seepage & Underseepage	Sta 212+00 - 219+55: cutoff wall through embankment to El. 20 (~45') Sta 219+55 - 221+50: no work - existing cutoff wall through embankment
8	1	Sta. 221+50 to Sta. 249+00	4A	Underseepage Only	Sta 221+50 - 249+00: S-B cutoff wall through foundation under w/s shell to El. -15 (~60' - 65') Sta. 229+50: Install Piezometer (Adjust location based on cutoff wall soils)
9	3	Sta. 570+00 to Sta. 594+00	6	Through-Seepage & Underseepage	Sta. 570+00 - 575+00: cutoff wall through embankment to El. 22 (~58 ft) Sta. 575+00 - 587+00: cutoff wall through embankment to El. 15 (~65 ft) Sta. 587+00 - 594+00: cutoff wall through embankment to El. 20 (~60 ft)
10	3	Sta. 594+00 to Sta. 658+50	6	Through-Seepage & Underseepage	Sta 594+00 - 612+00: cutoff wall through embankment to El.40 (~35') Sta 612+00 - 619+00: cutoff wall through embankment to El. 30 (~45') Sta 619+00 - 624+00: cutoff wall through embankment to El. 40 (~35') Sta 624+00 - 632+00: cutoff wall through embankment to El. 20 (~55') Sta 631+00 - 657+00: new 20' wide berm to 200-yr water surface elevation Sta 630+00: Install piezometer Sta 657+00 - 658+50: no work
11	3	Sta. 658+50 to Sta. 724+00	7	No Seepage Problem Localized Waterside Slopes Too Steep Localized Freeboard Deficiencies	Sta 659+00 - 690+00: construct waterside fill on slope at 3(min)H:1(V) Sta 714+00 - 724+20: levee crown reshaping and UPRR flood gate Sta 670+00 & 705+00: Install piezometer (inc. open standpipe @ Sta 705+00)



PROJECT LOCATION MAP

0 5,000 10,000 20,000

SCALE, FEET



VICINITY MAP

0 40 80

SCALE, MILES

	Bookman-Edmonston A Division of GEI Consultants	THREE RIVERS LEVEE IMPROVEMENT AUTHORITY Government Center 915 Eighth Street, Suite 115 Marysville, CA 95901-5273 GEI Project 050115	PHASE 4 FEATHER RIVER LEVEE REPAIR PROJECT Reclamation District 784 Yuba County, California SITE VICINITY, PROJECT LOCATION MAP	FIGURE 1

K:\050115-5 TRLIA Feather River Levee Repairs\Design Report\Issue forApproval Figures - March 2007\Figure 1_site location map.dwg

Figure 2

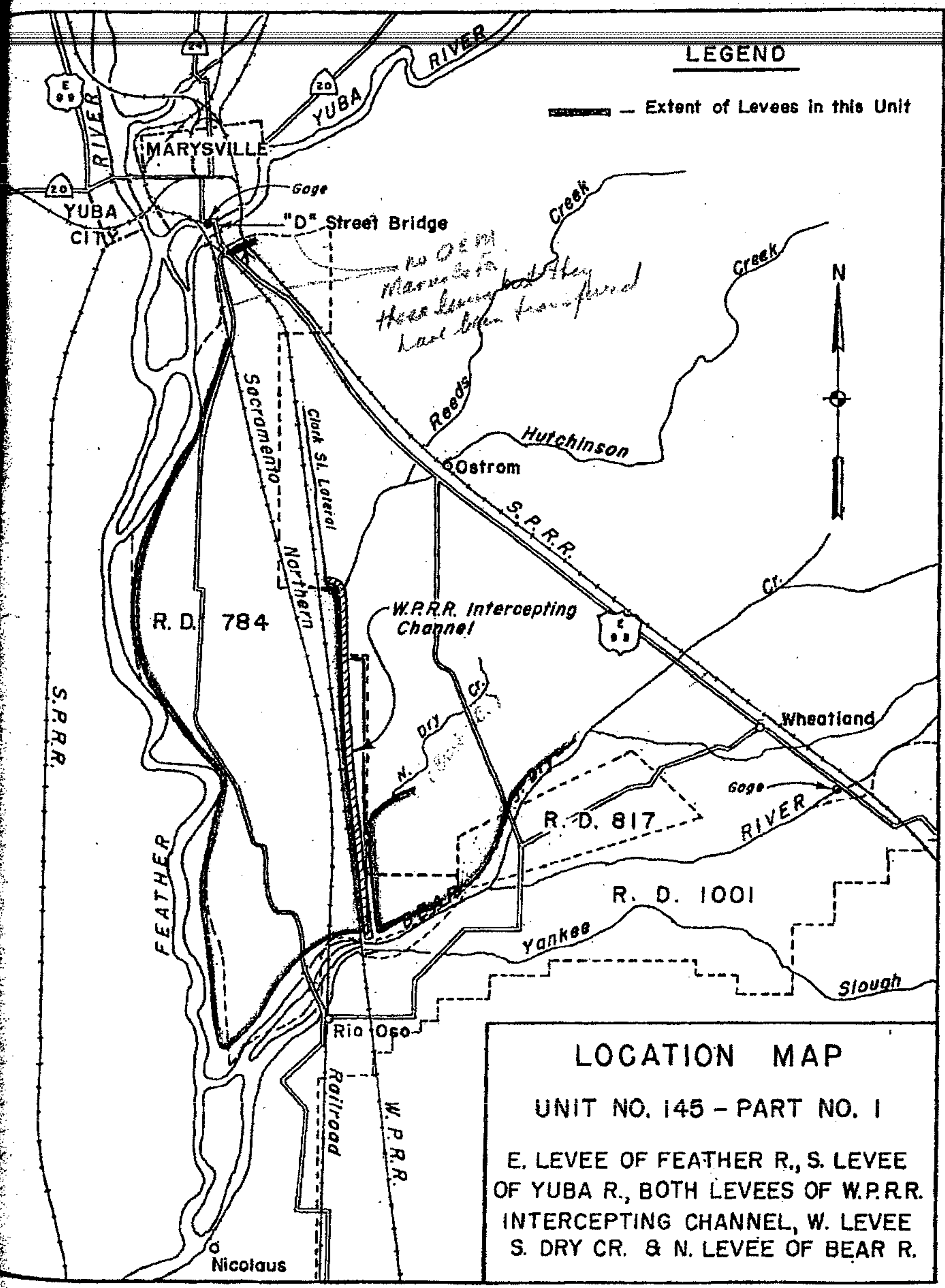

LEGEND
Extent of Levees in this Unit
MARYSVILLE
YUBA CITY
YUBA RIVER
RIVER
"D" Street Bridge
Gage
Creek
Creek
Reeds
Hutchinson
Ostrom
S.P.R.R.
Sacramento Northern
Clark Sl. Lateral
R. D. 784
W.P.R.R. Intercepting Channel
Cr.
N. Dry Cr.
S. Dry Cr.
Wheatland
Gage
R. D. 817
BEAR RIVER
R. D. 1001
Yankee Slough
FEATHER
S.P.R.R.
Rio Oso
Railroad
W.P.R.R.
Nicolaus
N
LOCATION MAP
UNIT NO. 145 - PART NO. 1
E. LEVEE OF FEATHER R., S. LEVEE OF YUBA R., BOTH LEVEES OF W.P.R.R. INTERCEPTING CHANNEL, W. LEVEE S. DRY CR. & N. LEVEE OF BEAR R.

FIGURE 25
1-in-100 and 1-in-200 AEP Water Surface Profiles for Feather River from Yuba River to Bear River

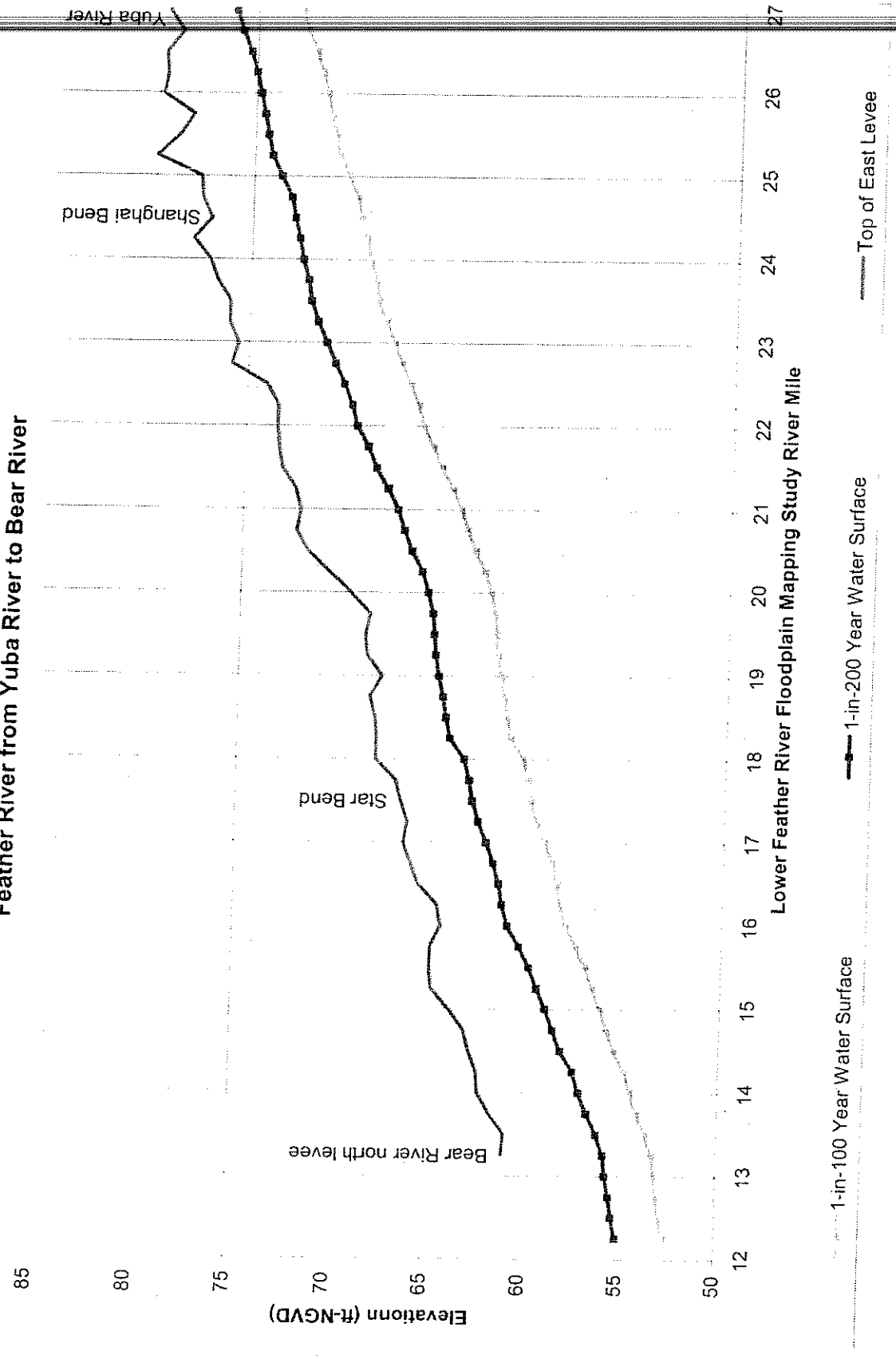


FIGURE 28

1-in-100 and 1-in-200 AEP Water Surface Profile for Yuba River

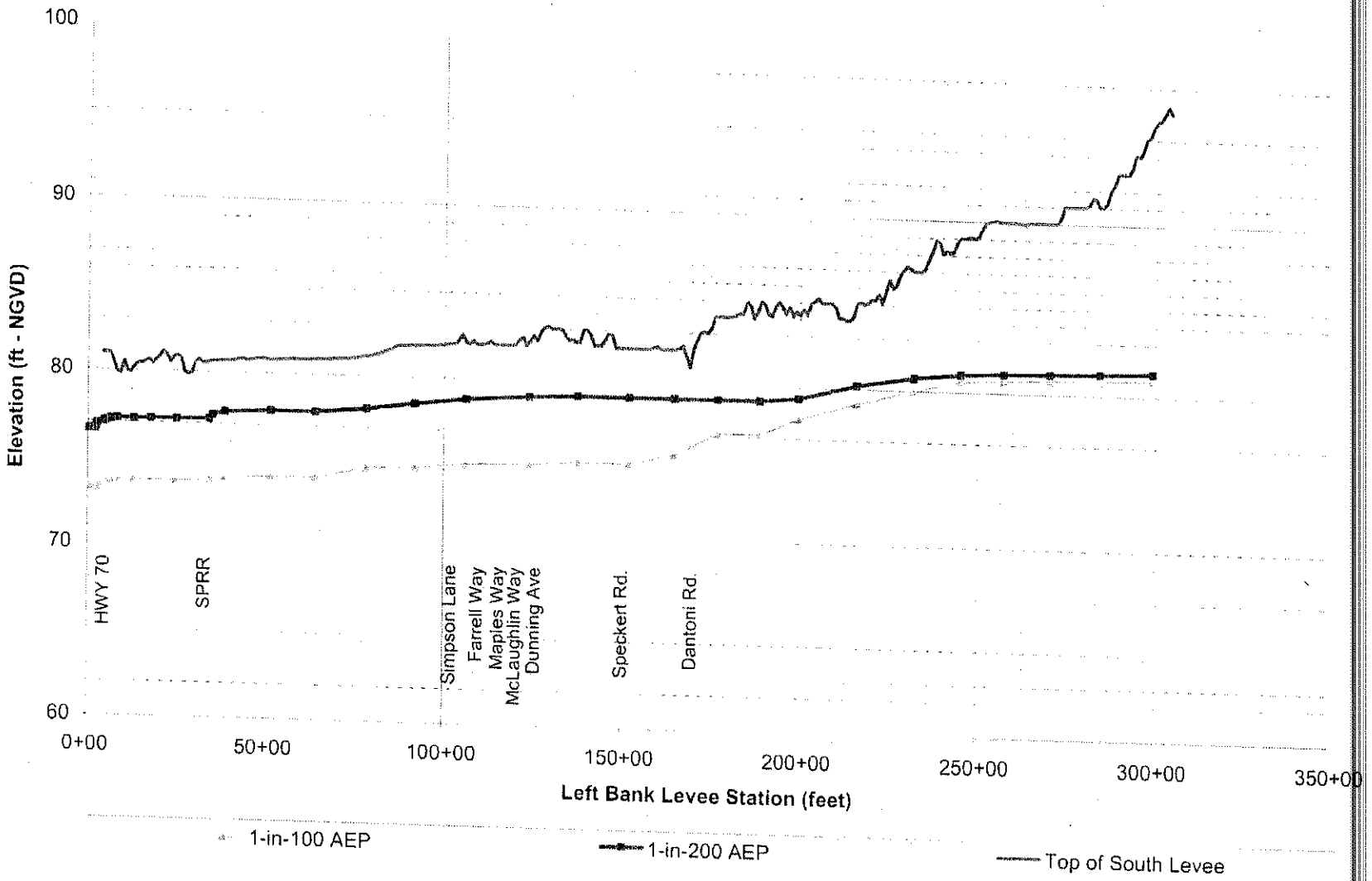
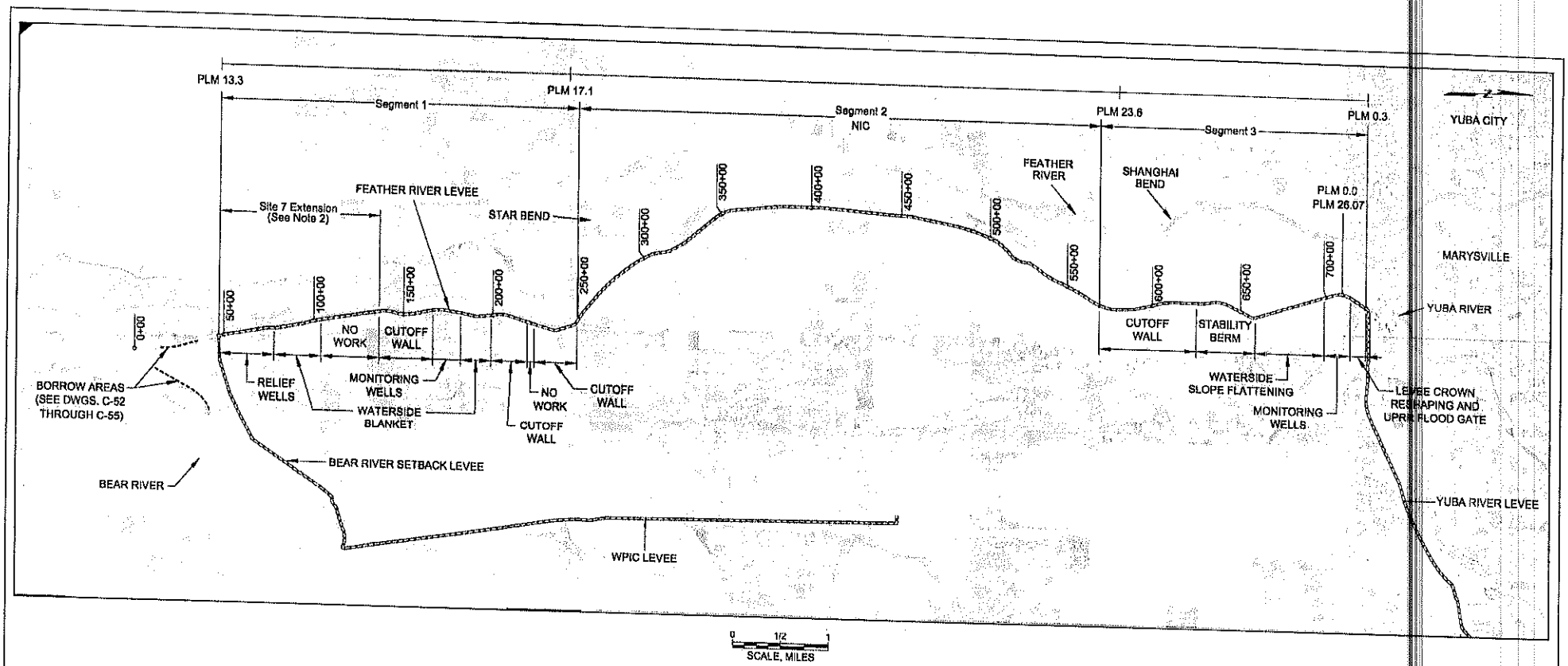


Figure 4



LEGEND

- EXISTING LEVEE
- REMNANT LEVEE EMBANKMENTS
- 200+00 PHASE 4 LEVEE STATIONING
- PLM 17.1 PROJECT LEVEE MILE STATIONING

NOTES

1. SEE NOTE REGARDING TOPOGRAPHIC SURVEYS AND IMAGES ON DWG. C-1.
2. SITE 7 EXTENSION IS LOCATED FROM STA. 44+90 TO 136+37 WITHIN SEGMENT 1. HOWEVER, QUANTITIES FOR SEGMENT 1 GIVEN IN THE BID SCHEDULE DO NOT INCLUDE QUANTITIES FOR SITE 7 EXTENSION, WHICH ARE LISTED SEPARATELY.

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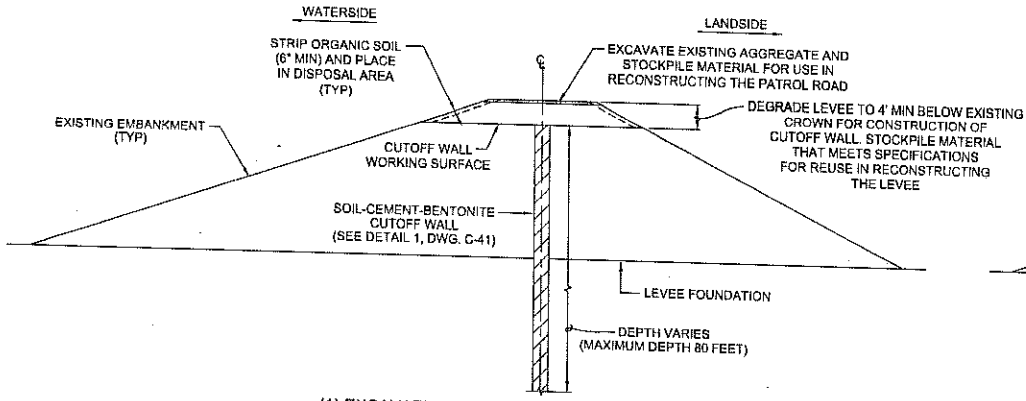
PHASE 4 FEATHER RIVER LEVEE REPAIR PROJECT
Reclamation District No. 784
Yuba County, California

SITE PLAN

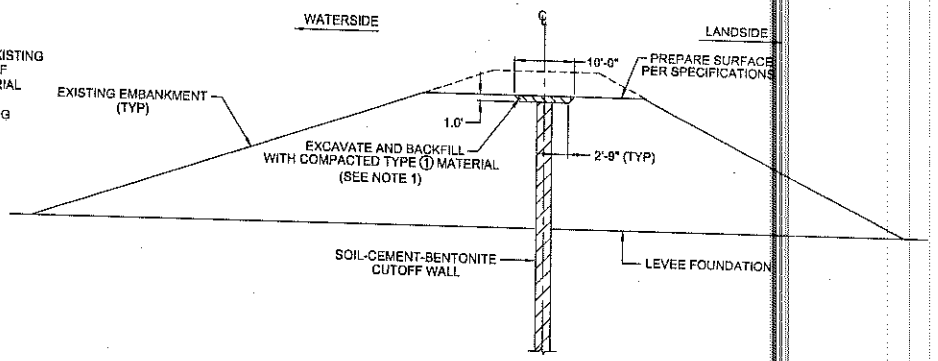
DWG. NO. G-4

C-1 03-23-07 RDS



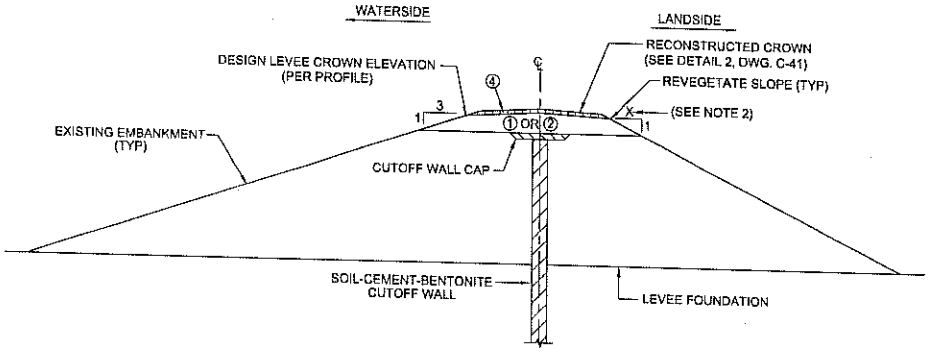
(1) EXCAVATION AND CUTOFF WALL CONSTRUCTION

0 10 20
SCALE, FEET



(2) WORKING SURFACE PREPARATION FOR LEVEE RECONSTRUCTION

0 10 20
SCALE, FEET



(3A) LEVEE RECONSTRUCTION OPTION 1

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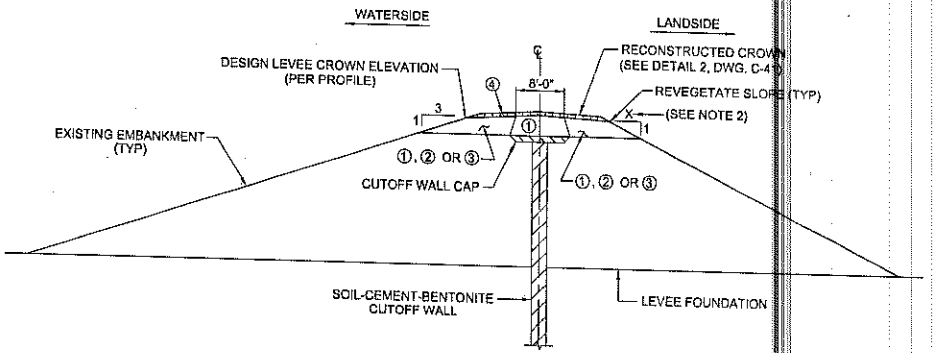
SCALE, FEET



(3B) LEVEE RECONSTRUCTION OPTION 2

0 10 20
SCALE, FEET

CUTOFF WALL REACHES

STA 135+00 TO 166+50
STA 198+00 TO 219+75
STA 570+00 TO 632+00

FILL MATERIAL TYPE

① IMPERVIOUS FILL
② LOW PERMEABILITY FILL
③ RANDOM FILL
④ AGGREGATE BASE

NOTES

1. MINIMUM DIMENSIONS OF CUTOFF WALL CAP ARE SHOWN. THE CONTRACTOR MAY ELECT TO ENLARGE CAP FOR IMPROVED MATERIAL USAGE OR IMPROVED CONSTRUCTABILITY.
2. SOUTH OF STATION 614+00, RECONSTRUCTED SLOPE SHALL BE 3H:1V OR THE SAME AS EXISTING SLOPE BELOW DEGRADATION, WHICHEVER IS STEEPER. NORTH OF STATION 615+00, RECONSTRUCTED SLOPE SHALL BE 2H:1V. CONTRACTOR SHALL TRANSITION FROM 3H:1V TO 2H:1V BETWEEN STATIONS 614+00 AND 615+00. SEE TABLE ON DWG. C-41 FOR DESIGN SLOPE INFORMATION.

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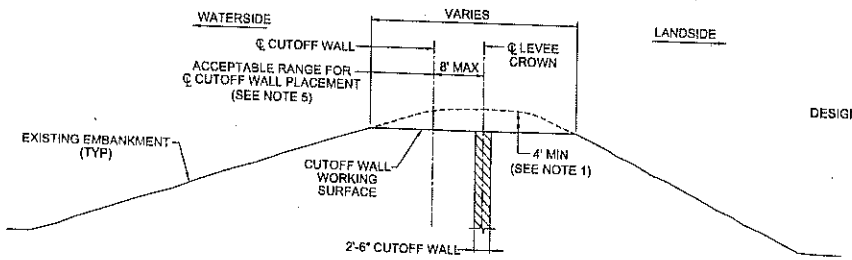
PHASE 4 FEATHER RIVER LEVEE REPAIR PROJECT
Reclamation District No. 784
Yuba County, California

SOIL-CEMENT-BENTONITE CUTOFF WALL CONSTRUCTION SEQUENCE

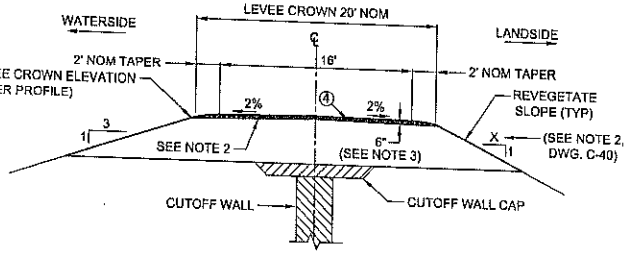
DWG. NO. C-40

C-40 03-19-07 PM



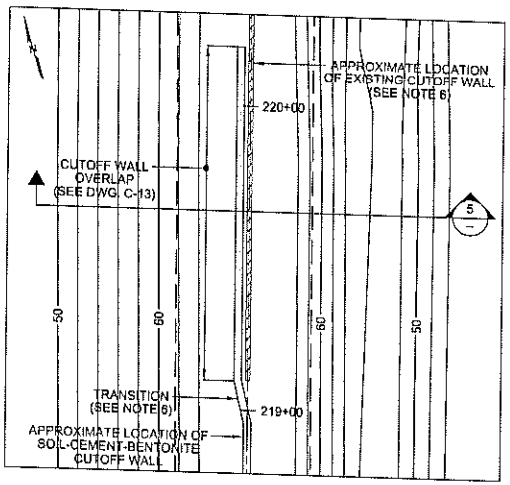
CUTOFF WALL LOCATION DETAIL (1)

SCALE, FEET



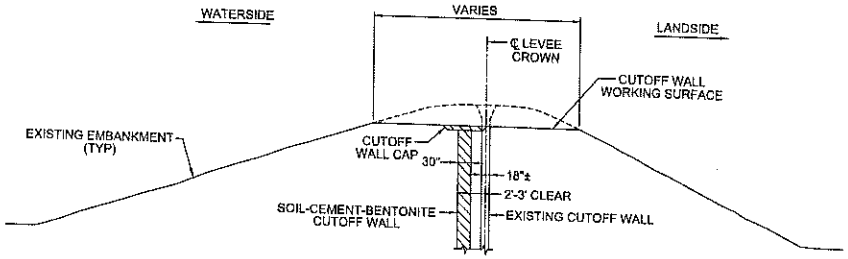
TYPICAL CROWN SURFACING DETAIL (2)

SCALE, FEET



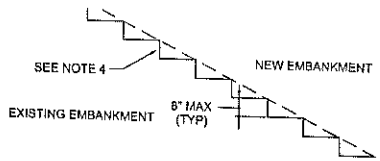
CUTOFF WALL OVERLAP PLAN (4) C-13

SCALE, FEET



TYPICAL CUTOFF WALL OVERLAP DESIGN STA 219+10 TO STA 220+20 (5)

SCALE, FEET



SLOPE BENCHING DETAIL (3)

(NTS)

Phase 4 Levee Station	Waterside Slope (H : V)	Landside Slope (H : V)	Crown Width (ft)
135+00	3.0 : 1	2.8 : 1	17.4
140+00	3.0 : 1	3.0 : 1	15.2
145+00	3.0 : 1	3.0 : 1	16.6
150+00	3.0 : 1	3.0 : 1	18.5
155+00	3.0 : 1	3.0 : 1	26.4
160+00	3.0 : 1	2.7 : 1	16.1
165+00	3.0 : 1	2.8 : 1	21.7
200+00	3.0 : 1	2.5 : 1	22.3
205+00	3.0 : 1	2.1 : 1	22.5
210+00	3.0 : 1	2.2 : 1	22.7
215+00	3.0 : 1	2.4 : 1	19.0
219+55	3.0 : 1	2.7 : 1	24.1
570+00	3.0 : 1	3.0 : 1	18.4
575+00	3.0 : 1	3.0 : 1	16.3
580+00	3.0 : 1	2.8 : 1	19.6
585+00	3.0 : 1	3.0 : 1	29.8
590+00	3.0 : 1	3.0 : 1	26.6
595+00	3.0 : 1	2.9 : 1	16.9
600+00	3.0 : 1	3.0 : 1	15.6
605+00	3.0 : 1	3.0 : 1	21.0
610+00	3.0 : 1	3.0 : 1	22.1
615+00	3.0 : 1	2.0 : 1	17.7
620+00	3.0 : 1	2.0 : 1	19.9
624+00	3.0 : 1	2.0 : 1	17.0
630+00	3.0 : 1	2.0 : 1	21.1

FILL MATERIAL TYPE

④ AGGREGATE BASE

NOTES

1. BEFORE CONSTRUCTING SLURRY TRENCH, CONTRACTOR SHALL DEGRADE LEVEE CROWN BY 4 FEET MINIMUM OR AS DIRECTED BY ENGINEER.
2. COMPACT UPPER 12 INCHES OF LEVEE FILL MATERIAL TO 100 PER ASTM D698 BEFORE PLACING ROADWAY AGGREGATE.
3. ROAD SURFACING SHALL CONSIST OF AN INITIAL 4-INCH LAYER OF ROAD BASE SALVAGED FROM THE EXISTING LEVEE, COVERED BY A 2-INCH LAYER OF ROAD BASE IMPORTED FROM AN APPROVED COMMERCIAL SOURCE.
4. PLACE FILL IN HORIZONTAL LIFTS AGAINST VERTICAL FACES CUT INTO EXISTING LEVEE MATERIAL.
5. DISTANCE BETWEEN ℄ LEVEE CROWN AND ℄ CUTOFF WALL SHALL BE CONSTANT FOR EACH CUTOFF WALL.
6. CONTRACTOR SHALL DESIGN TRANSITION IN ALIGNMENT OF CUTOFF WALL TO MATCH OVERLAP WITH EXISTING CUTOFF WALL SHOWN AND SUBMIT TO ENGINEER FOR REVIEW AND APPROVAL. CONTRACTOR SHALL SURVEY LOCATION OF EXISTING CUTOFF WALL AND SUBMIT WITH TRANSITION DESIGN.

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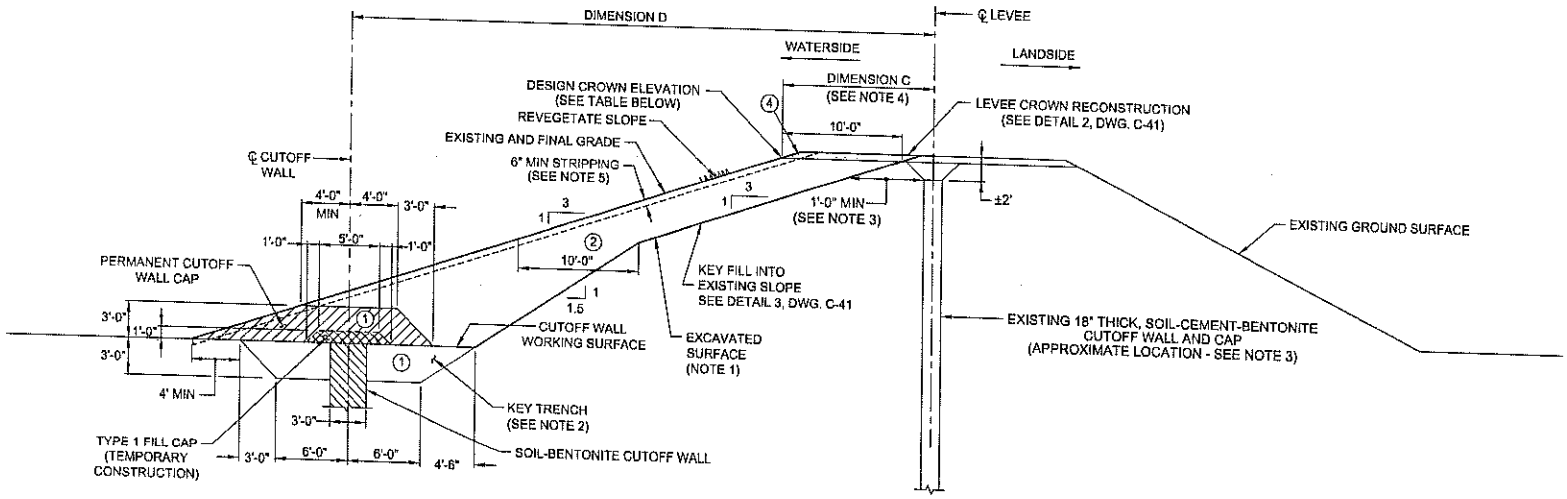
Reclamation District No. 784
Yuba County, California

SOIL-CEMENT-BENTONITE CUTOFF WALL TYPICAL DETAILS

DWG. NO. C-41

C-41 03-19-07 PM



TYPICAL WATERSIDE TOE CUTOFF WALL
STA 221+50 TO 249+00

0 5 10
SCALE, FEET

Station	Top of Cutoff Wall Elevation	Design Waterside Hinge Point (Dimension C)	Cutoff Wall Offset Location (Dimension D)	Design Crown Elevation
222+00	48.7	13.0	50.9	65.7
223+00	48.3	12.5	51.6	65.7
224+00	48.7	13.5	51.9	65.8
225+00	49.1	14.5	51.6	65.8
226+00	49.5	14.7	50.9	65.9
227+00	49.9	10.8	46.1	66.0
228+00	50.3	10.1	44.3	66.0
229+00	50.2	14.7	50.2	66.0
230+00	50.2	16.9	51.4	66.0
231+00	50.6	12.0	45.2	66.0
232+00	51.0	10.0	36.0	67.4
233+00	51.4	15.5	48.4	66.0
234+00	51.7	14.0	43.9	66.0
235+00	52.1	13.8	42.3	66.0
236+00	52.5	9.9	37.6	66.0
237+00	52.9	9.0	35.2	66.0
238+00	53.2	8.2	33.7	66.0
239+00	52.8	9.3	35.9	66.0
240+00	52.4	9.0	37.2	66.1
241+00	52.0	8.3	37.7	66.1
242+00	52.4	8.7	36.8	66.1
243+00	52.8	8.6	35.3	66.1
244+00	52.7	11.4	38.5	66.1
245+00	52.7	10.9	38.1	66.1
246+00	52.9	5.1	31.8	66.1
247+00	52.5	8.8	36.8	66.2
248+00	52.1	10.1	39.4	66.2
249+00	51.7	12.3	43.1	66.3

NOTES

1. MATERIAL FROM EXCAVATION IS TO BE PLACED IN STOCKPILE FOR LEVEE RECONSTRUCTION IF IT MEETS TYPE ② SPECIFICATION FOR REUSE IN RECONSTRUCTING THE LEVEE. PLACE UNUSEABLE MATERIAL IN DISPOSAL AREA.
2. EXCAVATE KEY TRENCH AND BACKFILL WITH COMPACTED TYPE ① MATERIAL PRIOR TO SLURRY TRENCH CONSTRUCTION.
3. CONTRACTOR SHALL PRESERVE AND PROTECT EXISTING CUTOFF WALL. CONTRACTOR SHALL LOCATE THE TOP OF EXISTING CUTOFF WALL AT 100' INTERVALS ALONG LEVEE CROWN BY CAREFULLY EXCAVATING OVERLYING AGGREGATE BASE AND LEVEE FILL MATERIALS WITH SMALL HOLES OR NARROW TRENCHES. WIDTH OF LEVEE REMOVAL AND RECONSTRUCTION SHALL BE REDUCED INCREMENTALLY FROM 10' AT TOP OF 1.5(H) : 1(V) SLOPE TO 8' AT LEVEE CROWN IF NECESSARY TO AVOID EXISTING CUTOFF WALL BY 1' MINIMUM AS SHOWN.
4. REMOVE EXISTING AGGREGATE BASE MATERIAL AND STOCKPILE SEPARATELY FOR USE IN RECONSTRUCTING THE PATROL ROAD.
5. STRIP ORGANIC SOIL AND PLACE IN DISPOSAL AREA.

FILL MATERIAL TYPE
① IMPERVIOUS FILL
② LOW PERMEABILITY FILL
④ AGGREGATE BASE

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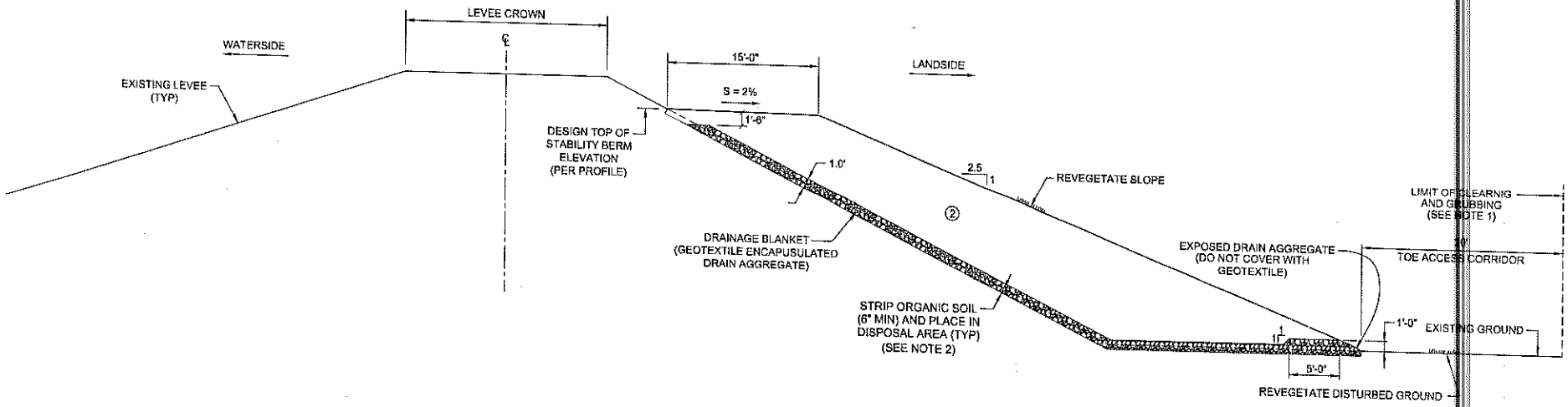
GEI Project 05011-5

PHASE 4 FEATHER RIVER LEVEE REPAIR PROJECT
Reclamation District No. 784
Yuba County, California

SOIL-BENTONITE CUTOFF WALL TYPICAL CROSS SECTION

DWG. NO. C-42

C-42 03-21-07 PW



TYPICAL LEVEE STABILITY BERM CROSS SECTION

STA. 631+00 TO 658+00

0 5 10

SCALE, FEET

NOTES

1. CLEAR AND GRUB AREAS WITH TREES AND BRUSH.
2. EXCAVATION BEYOND ORGANIC SOIL IS PROHIBITED.

FILL MATERIAL TYPE

② LOW PERMEABILITY FILL

NO	DATE	ISSUE/REVISION	DES	DRN	CH	APP
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Marysville, CA 95901-5273

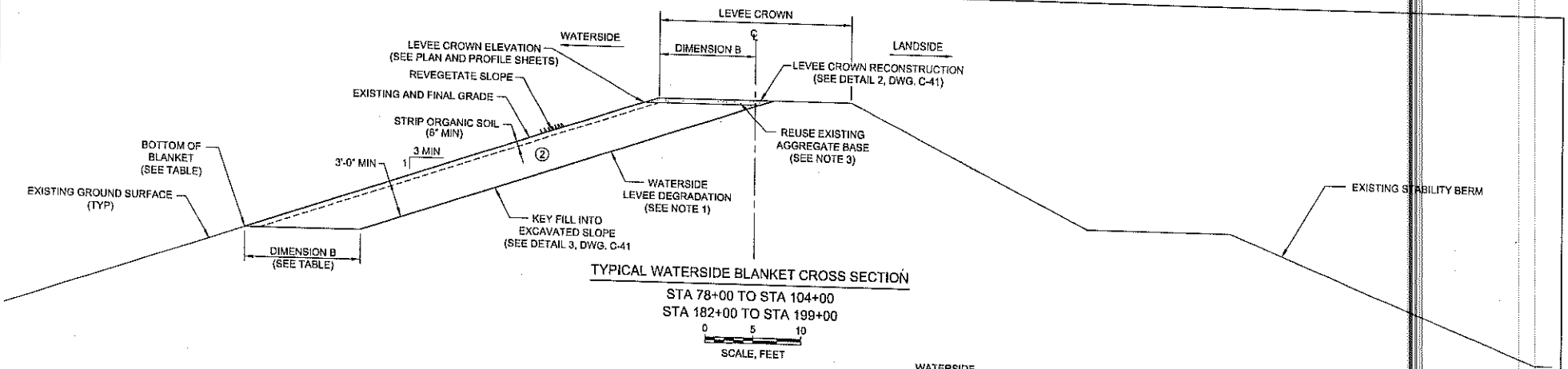
GEI Project 05011-5

PHASE 4 FEATHER RIVER LEVEE REPAIR PROJECT
Reclamation District No. 784
Yuba County, California

TYPICAL STABILITY BERM CROSS SECTION

DWG. NO. C-43

C-43 03-21-07 PM



TYPICAL WATERSIDE BLANKET CROSS SECTION

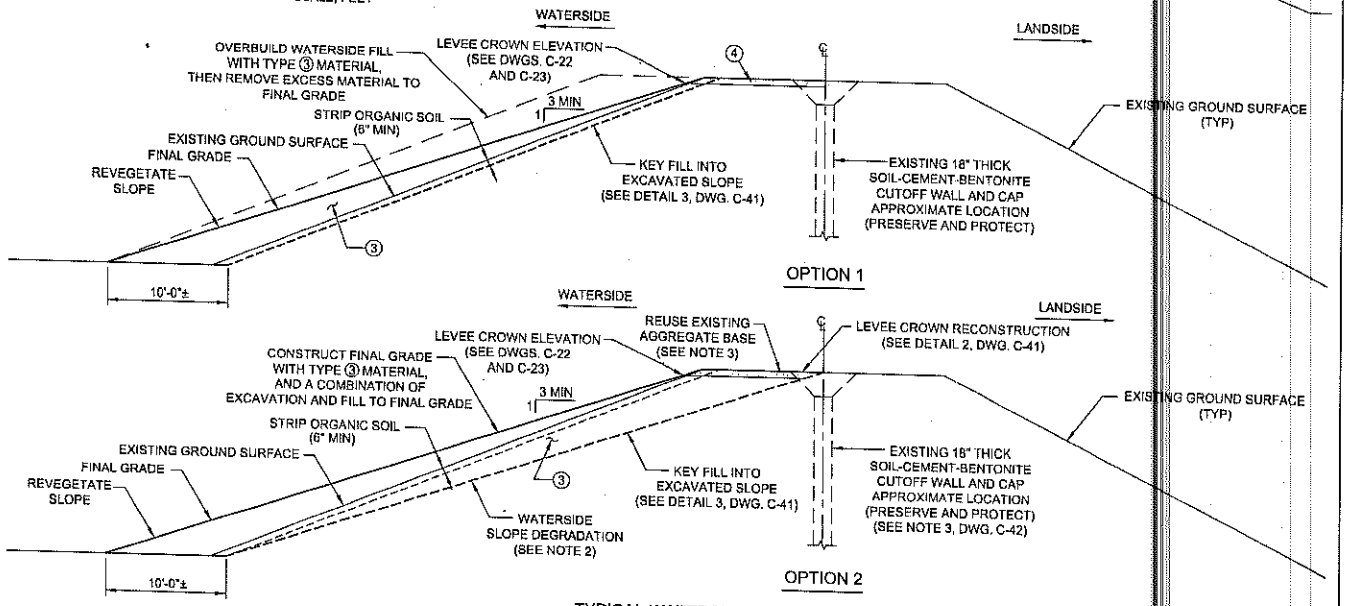
STA 78+00 TO STA 104+00
STA 182+00 TO STA 199+00

0 5 10
SCALE, FEET

Station	Minimum Horizontal Width (Dimension B)	Design Bottom of Waterside Blanket	Station	Minimum Horizontal Width (Dimension B)	Design Bottom of Waterside Blanket
78+00	16	44.5	101+00	12	46.3
79+00	16	44.5	102+00	12	46.4
80+00	16	44.5	103+00	12	46.5
81+00	16	44.6	104+00	12	46.5
82+00	16	44.7	182+00	12	49.5
83+00	16	44.8	183+00	12	49.5
84+00	16	44.9	184+00	12	49.5
85+00	16	45.0	185+00	12	49.5
86+00	16	45.3	186+00	12	49.5
87+00	16	45.5	187+00	12	49.5
88+00	16	45.7	188+00	12	49.5
89+00	16	46.0	189+00	12	49.5
90+00	16	46.2	190+00	12	49.5
91+00	16	46.3	191+00	12	49.6
92+00	16	46.3	192+00	12	49.7
93+00	16	46.3	193+00	12	49.7
94+00	16	46.3	194+00	12	49.8
95+00	16	46.3	195+00	12	49.9
96+00	16	46.3	196+00	12	49.9
97+00	16	46.3	197+00	12	49.9
98+00	16	46.3	198+00	12	50.0
99+00	12	46.3	199+00	12	50.0
100+00	12	46.3			

NOTES

1. DEGRADE WATERSIDE SLOPE TO BOTTOM ELEVATION SHOWN ON PLAN AND PROFILE DRAWINGS. MATERIAL FROM EXCAVATION IS TO BE PLACED IN STOCKPILE FOR LEVEE IF IT MEETS TYPE ② SPECIFICATION FOR REUSE IN RECONSTRUCTING THE LEVEE. PLACE UNUSEABLE MATERIAL IN DISPOSAL AREA.
2. MATERIAL FROM EXCAVATION IS TO BE PLACED IN STOCKPILE FOR LEVEE RECONSTRUCTION IF IT MEETS TYPE ③ SPECIFICATION FOR REUSE IN RECONSTRUCTING THE LEVEE. PLACE UNUSEABLE MATERIAL IN DISPOSAL AREA.
3. REMOVE EXISTING AGGREGATE BASE MATERIAL AND STOCKPILE SEPARATELY FOR USE IN RECONSTRUCTING THE PATROL ROAD.
4. CONTRACTOR SHALL SELECT OPTION 1 OR OPTION 2 FOR WATERSIDE SLOPE FLATTENING.



TYPICAL WATERSIDE SLOPE FLATTENING CROSS SECTION

(SEE NOTE 4)
STA 660+00 TO STA 690+00

0 5 10
SCALE, FEET

FILL MATERIAL TYPE
② LOW PERMEABILITY FILL
③ RANDOM FILL
④ AGGREGATE BASE

NO.	DATE	ISSUE/REVISION	RS DES	PM DRN	FG CH	AP APP
A	03-23-07	ISSUED FOR BID				

Bookman-Edmonston
A Division of GEI Consultants

THREE RIVERS LEVEE IMPROVEMENT AUTHORITY
Government Center
915 Eighth Street, Suite 115
Marysville, CA 95901-5273

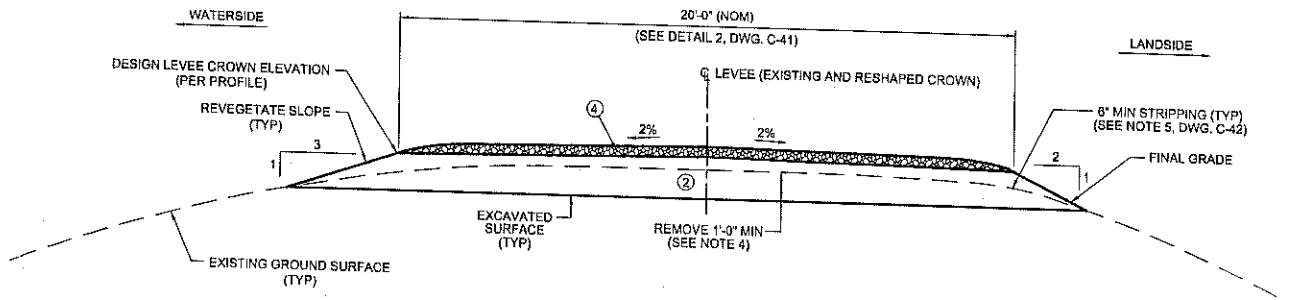
GEI Project 05011-5

PHASE 4 FEATHER RIVER LEVEE REPAIR PROJECT
Reclamation District No. 784
Yuba County, California

TYPICAL WATERSIDE FILL CROSS SECTION

DWG. NO. C-44

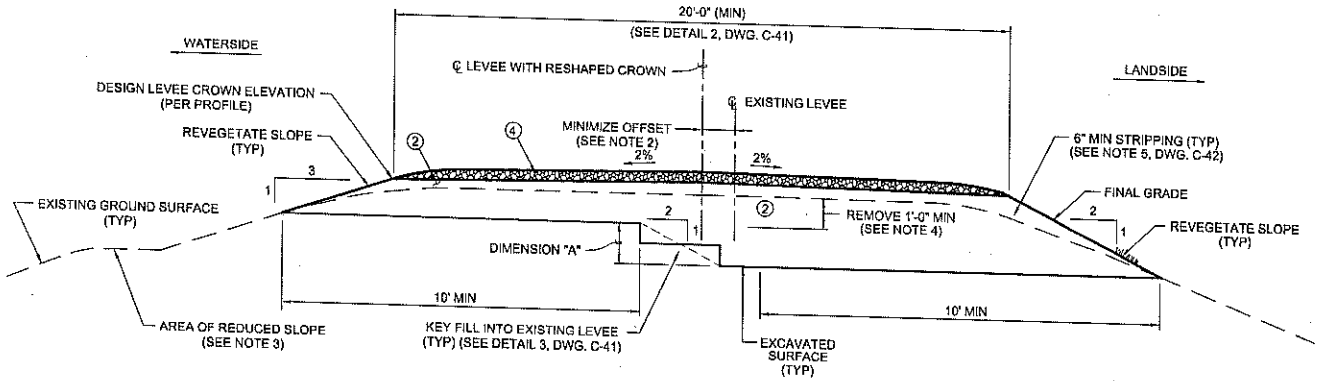
C-44 03-21-07 PM



DETAIL - CROWN RESHAPING SECTION 1

0 2 4

SCALE, FEET



DETAIL - CROWN RESHAPING SECTION 2

0 2 4

SCALE, FEET

LEGEND

② LOW PERMEABILITY FILL

④ AGGREGATE BASE

LIMITS OF CROWN RESHAPING		
STA	SECTION USED	DIMENSION "A" VALUE
718+73	1	N/A
717+73	2	5.0
716+73	2	2.0
715+73	2	0.4
714+73	1	N/A

NOTES

1. CROWN RESHAPING SHALL CONSIST OF SECTION 1 OR SECTION 2, AS SHOWN ON THE TABLE.
2. ANY LEVEE CENTERLINE OFFSET SHALL BE TRANSITIONED WITHOUT ABRUPT CHANGES IN DIRECTION TO EXISTING LEVEE CENTERLINE AT EACH END OF CROWN RESHAPING SEGMENTS.
3. CROWN RESHAPING SHALL NOT REDUCE THE WIDTH OF ADJACENT RAMPS UNLESS OTHERWISE APPROVED BY THE ENGINEER AND RD 784.
4. REMOVE EXISTING AGGREGATE MATERIALS AND STOCKPILE FOR USE IN RECONSTRUCTING THE PATROL ROAD.

NO	DATE	ISSUE/REVISION	DES	DRN	CH	APP
A	03-23-07	ISSUED FOR BID	FG	PM	RS	AP

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PHASE 4 FEATHER RIVER LEVEE REPAIR PROJECT
Reclamation District No. 784
Yuba County, California

LEVEE CROWN RESHAPING DETAILS

DWG. NO. C-45

C-45 03-19-07 PM

DRAFT COOPERATION AGREEMENT

-To be sent in a separate mailing or distributed at the Board meeting -